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C.F.T.R.I., MYSORE

CURRENT TOPIC

HEALTH AND NUTRITION OF TRIBALS

There are over 400 Scheduled Tribes which constitute about 7% of our country's vast population. The Tribals form different biosociocultural and ethinic groups living under varying ecosystems. They have remained primitive and underdeveloped – technologically and economically – because of their secluded habitat despite rapid progress and development in the country.

The Tribals can be broadly divided as belonging to one of the three principal territorial regions, namely the North-Eastern, the Central or the Southern region. In addition, the islands of Andaman and Nicobar constitute another small zone.

The North-Eastern zone consists of the Sub-Himalayan region and the mountainous areas east of the Testa Valley and the Jamuna-Padma portion of the River Brahmaputra. Tribes like Gurang, Lepcha, Aka Dafla, Abor - Miri, Mishmi, Mikir, Garo, Khasi and Naga group inhabit this region.

The Central region is formed by the plateaus and mountainous belts betwen the Indo-gangetic basin to the Krishna river in the South. It is inhabited by Santhals, Munda, Oraon, Ho, Savara, Baiga, Bhil, and Gonds etc.

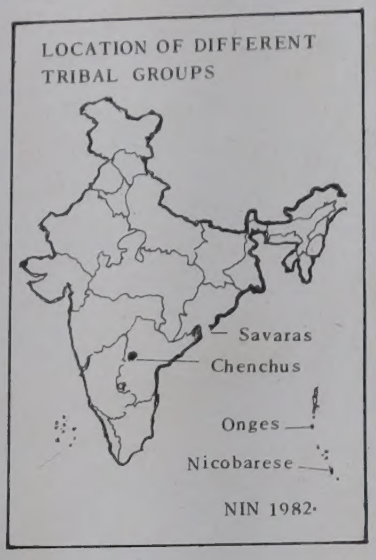
The Southern region consists of the Peninsular India falling South of Krishna River which is inhabited by Todas, Urali, Kanikkar and Chenchus etc. The small fourth zone of Andaman and Nicobar islands is inhabited by Nicobarese, Onges, Jarwas and North Sentinelese.

Means of living of these tribals range from hunting and collection of food in the forests to varying grades of agriculture – primitive shifting cultivation to settled agriculture. Because of their changing ecosystems, the tribals are perpetually in a state of trying to establish an equilibrium. This process is likely to make them vulnerable to health and nutrition disorders.

The National Institute of Nutrition (NIN) has conducted studies on some of the tribal groups (please see map). It was observed that tribals subsisting on forest had a better economic and nutrition status as compared to those depending on primitive cultivation. Improved agricultural technology and exploitation of natural resources had a beneficial effect on health and nutrition status. However infiltration of non-Tribals causing demolition of forest and other resources in the tribal areas and land alienation resulted in poor health status. Poor maternal and child health services and ineffective coverage of national health and nutrition programmes were found to be the main reasons for high child mortality and declining population groups like Onges and Andamanese.

However, large scale comprehensive studies covering all factors influencing health and nutrition sta-

tus of tribal populations are lacking. Based on findings of earlier studies by NIN, a situational-analysis is being conducted in the state of Madhya Pradesh, where about 22% of India's tribal population lives. Moreover, the central region of tribal concentration which encompasses Madhya Pradesh contributes to almost two thirds of the country's tribal population. The findings of this interdisciplinary study will help in the formulation of appropriate multisectoral health and related intervention models for the overall upliftment of the tribals. The epidemiologic study will form a base for monitoring and impact / effect evaluation of the emerging programmes.



Over 3,000 tribal families representing diverse-economic background (based on agriculture and/or forest resources) with varying access to and degree of utilization of the present health system in operation are being followed up on a longitudinal basis. The objective is also to ascertain the effect of different seasons on overall health and nutrition profile. Secondary information on existing developmental programmes is being collected from revenue and developmental departments at various levels in addition to data from the health department.

An explorative study covering about 100 Bhil families in Jhabua district and another 100 Gond households in Bastar district was recently conducted. The major occupation of these tribes was agriculture and almost all families possessed land though it was invariably limited to less than 5 acres. Locally consumed millets were extensively grown mixed with pulses. With no irrigation facilities and lack of modern agricultural technology, the crop yield was very poor. Marketing of produce and employment potentials in lean periods were adversely affected by poor storage facilities and communication system. In some areas where communication system was relatively better, cash crops such as cotton were grown and marketed. In these areas, the tribals migrated to neighbouring states during lean agricultural periods for earning wages. Their economic situation was better. Also, wherever the tribals could have an access to forest, collection of forest produce formed an important activity and source of livelihood during periods of no agricultural operation.

Possession of Livestock is a great economic asset amongst Bhils. Milk yields are reported to be very poor and it is used only for the calves. Traditional poultry was also popular.

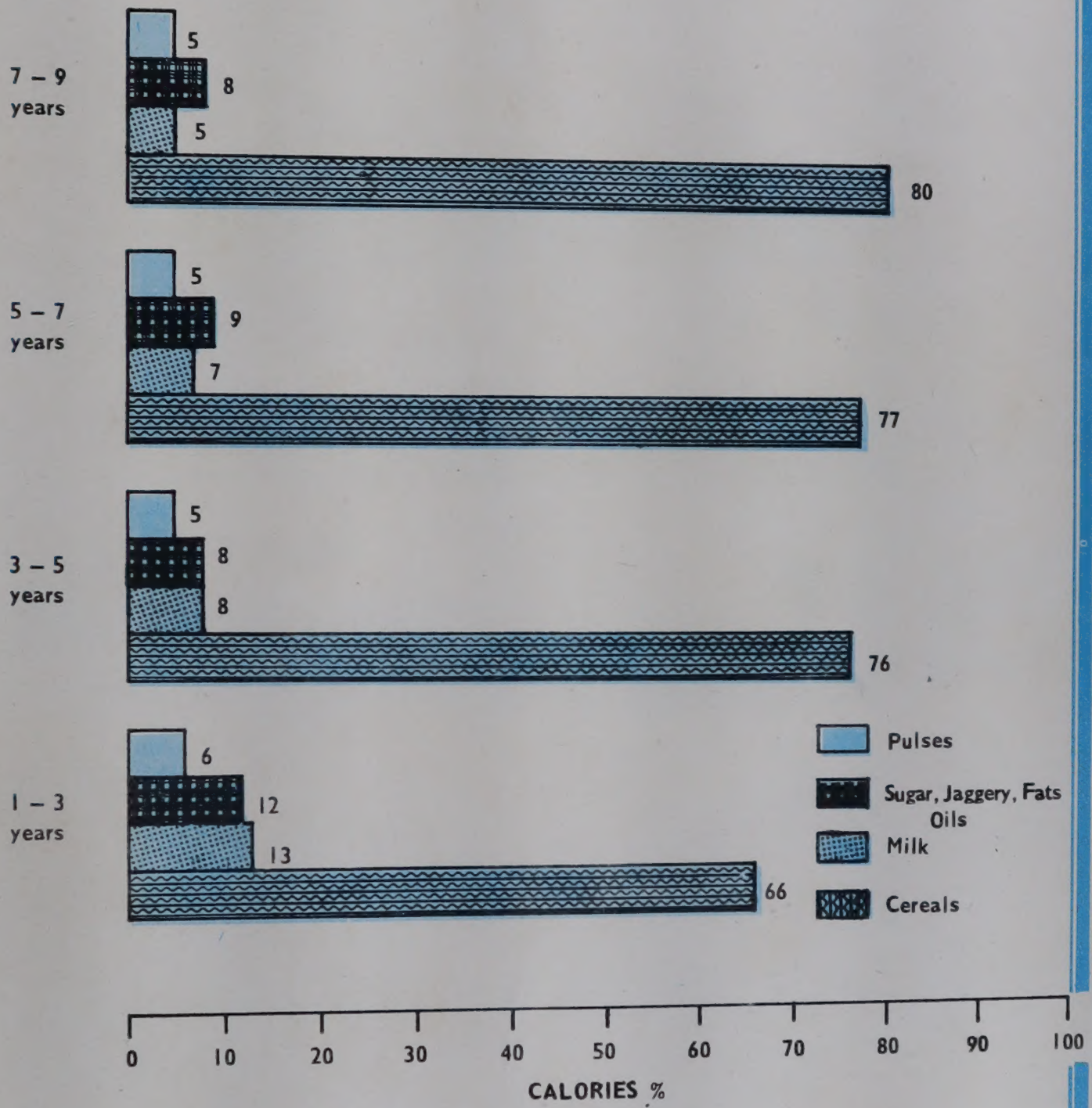
Most of these tribals live in nuclear families with average family size not different from that among the remaining population. Literacy rate is very low and almost 80% of the individuals are married by 15 years of age. Since women have an important contribution in the tribal economy, bride-price in cash or kind is in vogue. Widow remarriages are common. Expenditure on these social functions push their subsistence economy to a state of indebtedness to the local money-lenders, and they are seldom able to break this vicious circle.

Infant and child-rearing practices were found to be conducive to good nutritional status of this group. Colostrum is not discarded and while breast-feeding continues for as long as possible, early supplementation is practised.

The wide scatter of households, poor communication facilities and inadequacy of health staff are some hurdles resulting in a poor coverage of national health programmes. Untreated infections render the tribal populations vulnerable to health, making them victims of nutritional disorders.

PERCENTAGE TOTAL CALORIES DERIVED FROM DIFFERENT FOODS IN DIFFERENT AGE GROUPS

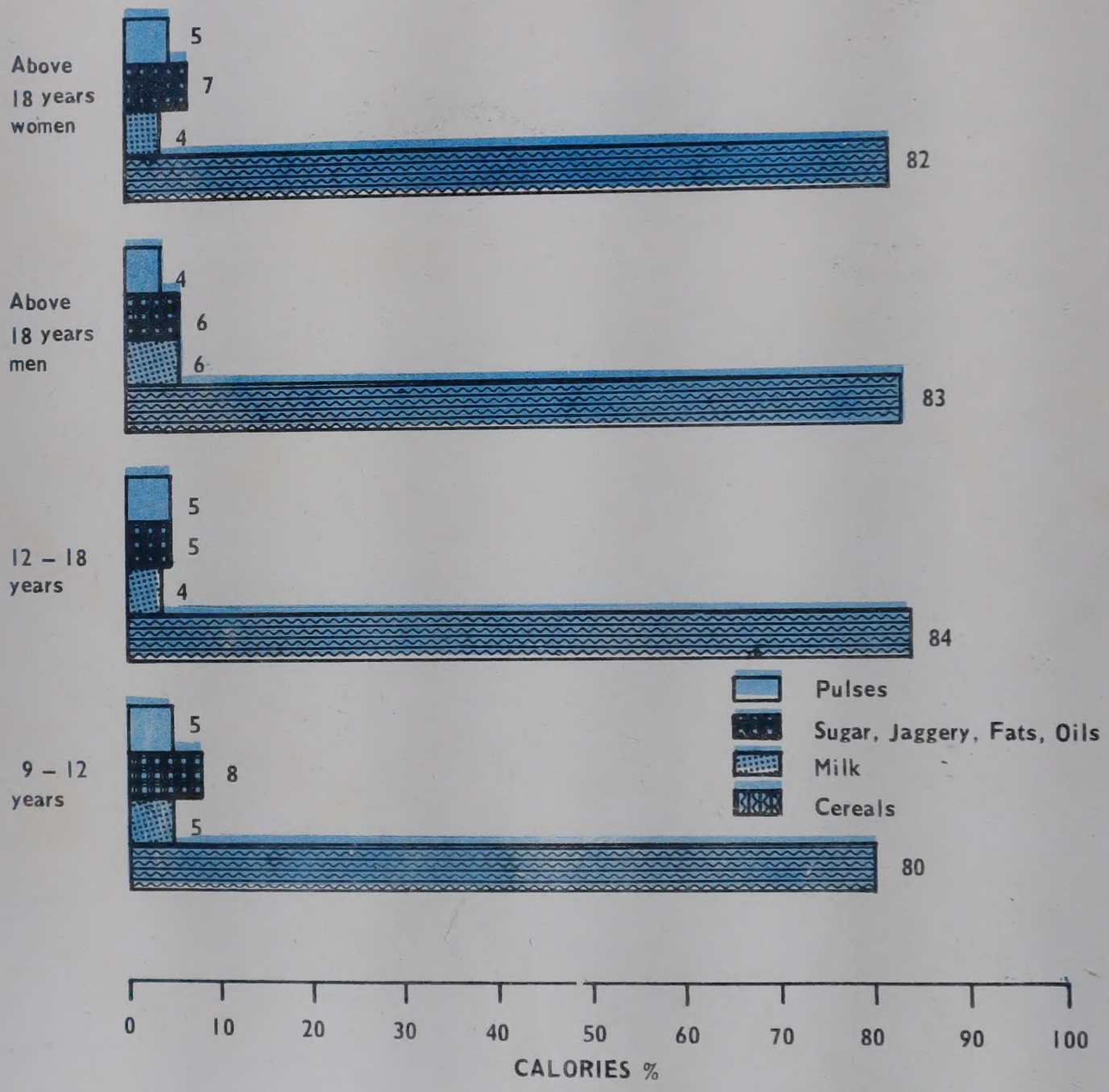
(Source : NNMB Data – 1975 – 79, NIN)*



*Diet Survey Data from Rural House-holds in Andhra Pradesh, India.

PERCENTAGE TOTAL CALORIES DERIVED FROM DIFFERENT FOODS IN DIFFERENT AGE GROUPS

(*Source* : NNMB *Data** – 1975–79, NIN)



*Diet Survey Data from Rural House-holds in Andhra Pradesh, India.

Detailed studies with regard to the types of traditional health systems, beliefs in allopathic and indigenous systems of medicine, family limitation concepts and practices in relation to demographic situations are in progress. Genetic, haematologic, immunologic and serologic studies in the overall context of the magnitude of morbidity are also being carried out.

Plans are afoot to extend these studies to some specific tribal groups such as 'Abhujmars' which are most primitive and isolated from outside world even till today. Their study will throw light on health and nutrition profile of primitive man in relation to his biosociocultural and physical environment. Such a study will also help in formulation of appropriate developmental programmes for the tribals such that their cultural entity is not lost.

Comprehensive studies of the type now in operation in Madhya Pradesh would soon be extended to the State of Orissa which also has a large tribal population. 'Podu cultivation' and Industrialization, as it exists there, will be studied for their influence on the overall health and nutrition profile of the tribals.

D. Hanumantha Rao, Y.N. Mathur and M.C. Swaminathan, NIN.

MEETINGS

ANNUAL MEETING OF THE INTERNATIONAL NUTRITIONAL ANAEMIA CONSULTATIVE GROUP (INACG)

The Seventh Annual Meeting of the International Nutritional Anaemia Consultative Group (INACG) was held at Indian Council of Medical Research, New Delhi, between April 19–22, 1983. INACG is a forum of researchers, policy-makers, scientists and representatives from countries where nutritional anaemia is a problem. The Group acts to guide international activities aimed at reducing nutritional anaemias around the world.

Over 70 outstanding nutrition experts from Bangladesh, Burma, Canada, Chile, Egypt, India, Indonesia, Mexico, Nepal, Philippines, Sweden, Switzerland, Thailand, U.S.A., Venezuela participated in the meeting. In the opening remarks, Prof. V. Ramalingaswami, Director-General, Indian Council of Medical Research, Dr. U. Ko Ko, Regional Director, WHO-SEARO, Dr. V.P. Kimati, UNICEF, and Dr. E.M. De Maeyer, Chairman, INACG, highlighted the health implications of Anaemia and the determination to take all steps for prevention and control of this health problem.

The Group also considered country reports on field trials including the supplementation and fortification programmes from Bangladesh, Burma, Chile, Egypt, Guatemala, Philippines, Thailand, and Venezuela. The Indian Programme of salt fortification and field trials with fortified salt conducted at Calcutta, Hyderabad and Madras centres were discussed.

The meeting considered the different methodologies of iron assessment and effects of iron deficiency on functional aspects such as work capacity and performance and thermal regulation. The question of integration of anaemia control programme with other sectors like Primary Health Care and MCH programme was also taken up for discussion.

SECOND AFRICAN NUTRITION CONGRESS

The Second African Nutrition Congress was organised in Ibadan, Nigeria, from February 27 – March 3,

Dear friend,

You have been receiving copies of Nutrition News for some time now. It is over four years since we have started publishing this newsletter. We felt it is time to indulge in a stocktaking exercise in the form of a Readership Profile Survey. We request you to participate in this survey.

Please do help us to bring out Nutrition News, making it more interesting and useful to you. Kindly fill in the enclosed proforma and mail it to us as soon as possible.

Yours sincerely,
Sd/ Editor

Thanking you,

P.S: We will be constrained to presume that you are not interested in receiving copies of Nutrition News in future, if we do not receive the filled-in proforma from you.

1983 by the Nutrition Society of Nigeria and Department of Human Nutrition, University of Ibadan, Nigeria and WHO along with other co-sponsors.

The theme of the Congress was "Foods and Nutrition in the 80's in Africa". The Congress was attended by over 160 delegates from different African countries and representatives from India, Australia, France and Denmark.

The Congress felt that African Governments should give top priority to food and nutrition policy in their development plans. Efforts for promoting rural development, breastfeeding and control of production, promotion and marketing of proprietary infant foods, support to nutrition education programmes were recommended.

RESEARCH NOTES

Cytotoxic effect of Vitamin E

The effect of different concentrations of Vitamin E on the survival of human lymphocytes *in vitro* was assessed by Trypan Blue exclusion method. The survival pattern of cells during 96 hour period of incubation was not much affected in the presence of vitamin E at levels similar to normal concentration in adult blood. However, percentage of cell death increased progressively with time and with increasing vitamin E concentration. Maximal rate of cell death occurred between 48 and 72 h.

The study indicates that vitamin E has cytotoxic effect on human lymphocytes *in vitro* at high concentrations, while being essentially non-toxic at physiological levels. This suggests that in *in vitro* investigations using lymphocytes, vitamin E should not be used at concentrations beyond the physiological level.

At this juncture, these results caution against the mega dose consumption of vitamin E in clinical practice.

Cereal-Millet intake as an indicator of Calorie adequacy

Cereals and millets constitute an important source of nutrients particularly energy in the Indian dietaries. The possibility of using consumption levels of cereals and millets alone as indicators to determine the calorie adequacy of individual dietaries at the community level was explored.

The total calories derived from cereals and millets decreased with increasing income. Critical cereal levels fo. individuals were calculated.

CRITICAL CEREAL/MILLET LEVELS (g./day)

Age (years)	*per capita income Rs./day* 2	2–5	5
1– 3	170	120	90
3– 5	210	170	120
5– 7	260	205	140
7– 9	290	240	180
9–12	325	240	240
12–18	410	375	335

Individuals should be consuming cereals and millets above the critical cereal levels indicated for their age and income group in order to meet their calorie requirements. The sensitivity and specificity for this level was observed to be around 80%.

These levels could be successfully used wherever cereals contribute more than 70% of the total calories. Otherwise, specific levels have to be recalculated.

TRAINING PROGRAMMES

The Sixteenth M.Sc. (Applied Nutrition) Course will be held between 1st June, 1983 and 29th February 1984. Two participants, one each from Jordan and Somalia and 8 participants from different States of India are expected to participate.

The Sixth Annual Certificate Course in Human Nutrition for Teachers from Agricultural Universities will be held from 1st June 1983 for a period of 2 months. 12 or 13 participants from faculties of agriculture in different Indian Agricultural Universities will undergo this course.

Editor: Dr. M. Mohan Ram; Assistant Editor: Indira Gopalan

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CURRENT TOPIC

EVALUATION OF NUTRITION PROGRAMMES

In the past, group feedings were invariably organised by religious and philanthropic institutions, either regularly or in times of stress caused by disasters drought, earthquakes, floods, wars, pestilence and crop failure. The main basis for these community feedings was human compassion. Today, most community feeding programmes have the explicit sanction of the State and Scientific community.

Supplementary Feeding (SFP) forms an important target oriented nutrition action programme. It is also one of the largest in terms of financial outlay and coverage. The main beneficiaries of such programmes are the nutritionally vulnerable pre-schoolers, school-children and pregnant and lactating women who account for about 40% of our total population.

Depending on the beneficiaries, sponsoring agency, type of food and the way it is delivered, SFP are named differently in different places. Crash programme, Special Nutrition Programme (SNP), Mid-day Meal (MDM) or School Meal Programme, Meal on wheels, Chief Ministers noon meal scheme are some of the popular names. At times, International and bi-national agencies like, WFP, CARE. OXFAM, SIDO, Indo-Dutch, DANIDA, lend their tags; Still all the SFP basically have the same objective with minor variations in content and strategy. In principle they aim to provide additional food to a target group to fill an observed gap between their intake and requirements. The ultimate aim is to improve nutrition status. The food is consumed either on-the spot of distribution or taken home by the beneficiaries. In most rural areas, the food is cooked on-the-spot; in some urban places centrally processed ready-to-eat food is distributed.

The programme for pre-school children aims at preventing marginal cases of undernutrition from lapsing into severe or fatal forms. For women, the main aim is to provide nutritional support during stress periods of pregnancy and lactation, so as to benefit the dependant offspring. School meals, apart from providing nutritional support, aim also at non-nutritional benefits like improvement in school enrollment or attendance by children from poor and backward communities. Other such non-nutritional goals include acceptance of family planning (IPP) immunization, education etc, (ICDS). In addition, these programmes are being viewed as part of overall development, education and welfare. This is in keeping with the current nutrition policy of the Government of India, whose 20-point programme recognises the need to link improved nutrition with health care, socio-economic development and productive activities involving women. The impact evaluation, of such a programme which not only has a broad-based objective but also several subsidiary objectives, poses methodological as well as organisational problems.

Evaluation

The definition of evaluation can be taken as a process of measuring progress towards a pre-set objective or goal. The essential pre-requisites are :

1. A clear-cut statement of measurable objectives and the strategy employed for achieving them in unambigous terms.
2. Knowledge of pre-programme (baseline) status of target group in terms of indicators used to measure the change.
3. Availability/identification of appropriate instruments and indicators of change, and
4. Feasible frame-work for evaluation.

Improvement in nutritional status of target group is stated as the main objective of SFP either operated singly or as part of other health and welfare activities. Even when this objective is not made explicit, the nutritionist assumes, and rightly so, that SFP should result in improvement of nutritional status of beneficiaries. Impact is therefore measured in terms of nutritional parameters like growth and nutritional morbidity. The temptation to look for improvement in growth and prevalence of nutritional deficiency signs is great. ***Even in programmes where feeding is added merely to serve as a "peg to hang the hat on", to realise non-nutritional goals, nutritionists take on the responsibility of evaluating nutritional impact in biological terms.*** Upon finding no improvement the tendency is to blame SFP, even if the more important desiderata are implementation strategy or delivery system. Evaluation of nutrition component of IPP in Karnataka is a point in evidence. The evaluation of School Meal Programme may also fall into this category.

The ideal and objective way of assessing impact of feeding on nutritional status is to compare information on related aspects on two groups before and after the feeding for

a specified period. The groups must be matched for age, sex and socio-economic background, the only differential being the supplement offered to one group. Such ideal situations are never present in many public health feeding programmes. ***Methods of evaluation which are independent of base-line information are not yet available.*** Comparing information on selected parameters of target population drawn from programme area and non-programme area is not entirely satisfactory.

Reliable information on supportive health inputs are not easy to obtain in community studies. It is also difficult to precisely measure the net increase in food intake of the beneficiary which is a factor dependant on whether the programme food is shared, if so how much and by whom. Intake assessment in quantitive terms is difficult without consumption studies. Interaction between health inputs and food intake greatly determines the ultimate observable change in nutritional status. It is difficult to quantify this interaction or assign proper weightage to its components. Whether the "*food*" factor out weighs the "*supportive measure*" factor or vice-versa is difficult to assess.

Inspite of these constraints, National Institute of Nutrition evaluated some major feeding programmes. One was operated as part of nutrition education (ANP) and another as a family planning programme (IPP). The SNP evaluation in tribal Andhra Pradesh and urban Karnataka showed improvement in nutritional status of beneficiary children as compared control groups. However, in situations where SFP was introduced to serve as an instrument of education or incentive for accepting family planning and other non-nutritional services (IPP, ANP), no significant changes were seen in nutritional indicators.

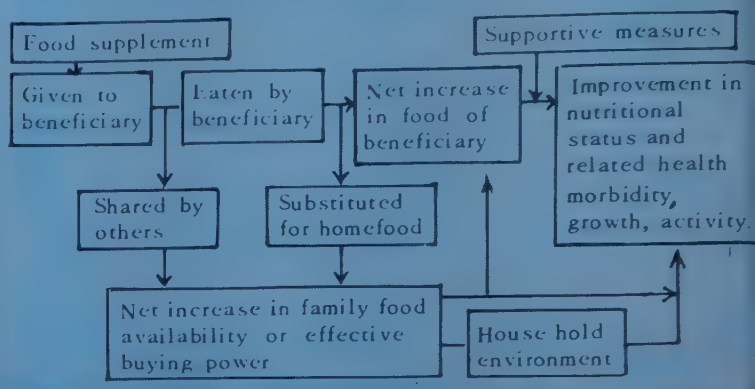
EVALUATION BY NIN

Programme	Objectives	Area / Population covered *	Impact on Nut. status.
Applied Nutrition Programme (ANP)	Nutrition education through demonstration etc.	Six States of India 75 villages 7107 houses 15014 children 244 functionaries	Sub optimal
India Population Project (IPP)	Acceptance of Family Planning, improved health, reduced morbidity	Karnataka 23 villages 1202 children 144 mothers	Sub optimal
Supplementary Nutrition Programme, Tribal area (SNP)	Improved nutritional status	Andhra Pradesh 9 tribal blocks 1908 children	Positive
Supplementary Nutrition Programme, Urban area	Improved nutritional status	Bangalore 15 slum areas 2028 children	Positive

* For evaluation.

Failure of the feeding component in these programmes is due partly to faulty strategies and partly to problems in delivery system. The failure cannot be attributed to non-acceptability of the programme nor to food i.e. Technology.

A FRAME WORK FOR EVALUATION OF SFP


Food supplement
Supportive measures
Given to beneficiary
Eaten by beneficiary
Net increase in food of beneficiary
Improvement in nutritional status and related health morbidity, growth, activity.
Shared by others
Substituted for homefood
Net increase in family food availability or effective buying power
House hold environment

In SFP 'raising the level of nutritional status' as a final goal is too general and diffuse an objective for quantitative assessment. Break down of this major objective into specific components and choosing of appropriate indicators for each one of the components, is the first step in evaluation. The second step consists of working out a feasible frame work for evaluation that identifies and sequentially arranges the likely factors which determine the outcome. The third step will be to reduce the programme operation into simpler constituents and convert them in to numerical terms. In technical jargon this would mean analytical breakdown of programme operation through the use of mathematical models which help not only in the identification of the crucial elements in a programme-operation but also in thinking quantitatively of their interactions.

Two mathematical models or equations which do not require knowledge of either advanced mathematics or computor science, are :

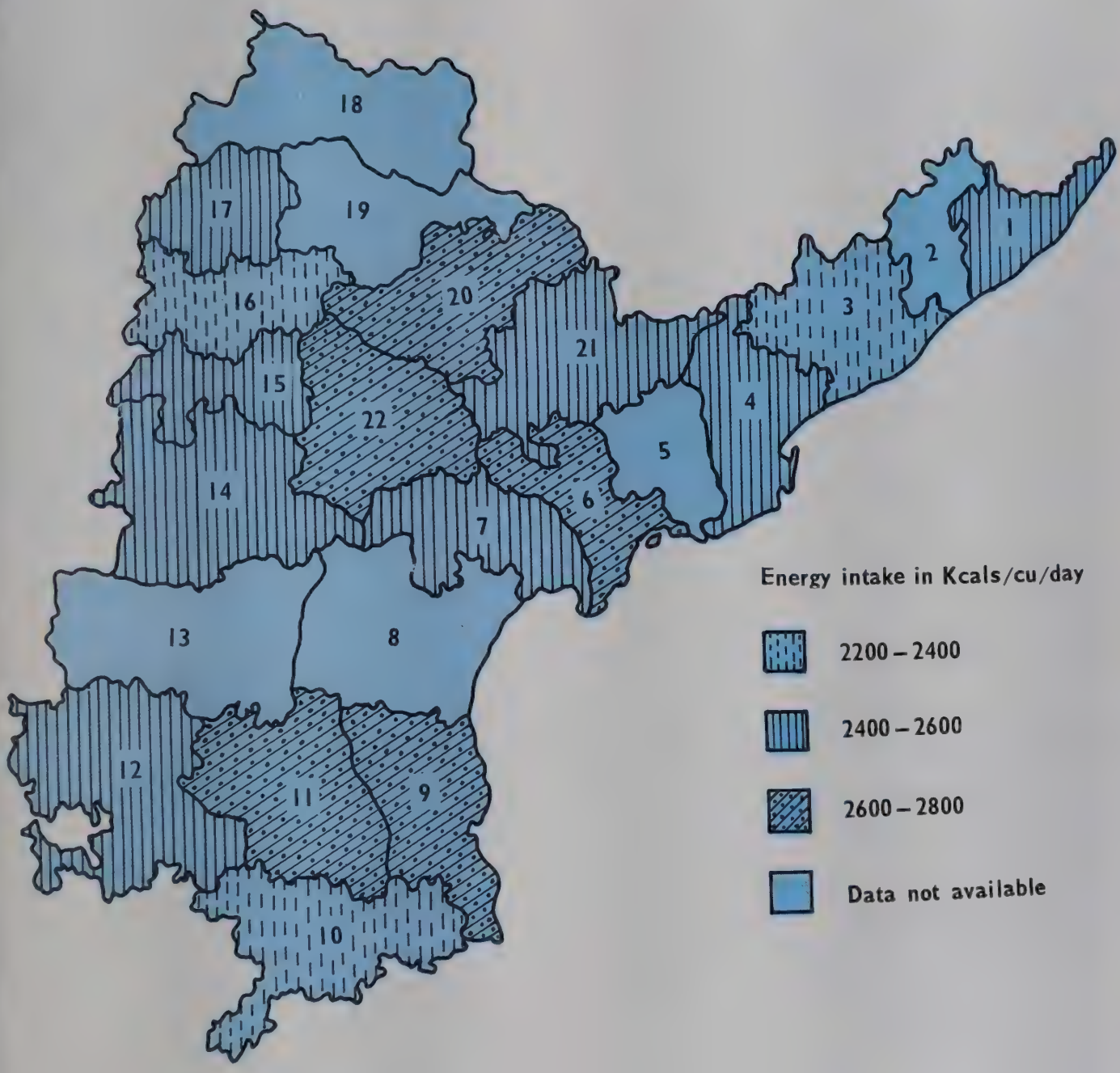
(i) ***Additive factors :*** $A + B + C = ?$
Wherein if A (or any other factor) equals or approches zero, at least the sum of the other two factors remains.
i.e. $0 + B + C = B + C$.

(ii) ***Multiplicative factors :*** $A \times B \times C = ?$
Wherein if A or any other factor equals or approaches zero, the product of the factors is zero.
i.e. $0 \times B \times C = 0$.

Action programmes of the supplementary feeding type operated singly (as in SNP) or as part of other programmes (as in ICDS, IPP etc.) belong to multiplicative factors model and not to additive factors model. The crucial and important sub-systems of the programme are: (1) the Technology (A) consisting of quality (a_1) and quantity of the food provided (a_2) (2) the delivery system (B) comprising of components like transport (b_1), storage (b_2), and mode of distribution / feeding (b_3) whether take-home or on the spot feeding (b_4) and, (3) the acceptability of the programme (C) by the target group. When these components are combined into an equation the effectiveness of the Supplemen-

AVERAGE CONSUMPTION OF CALORIES – RURAL ANDHRA PRADESH

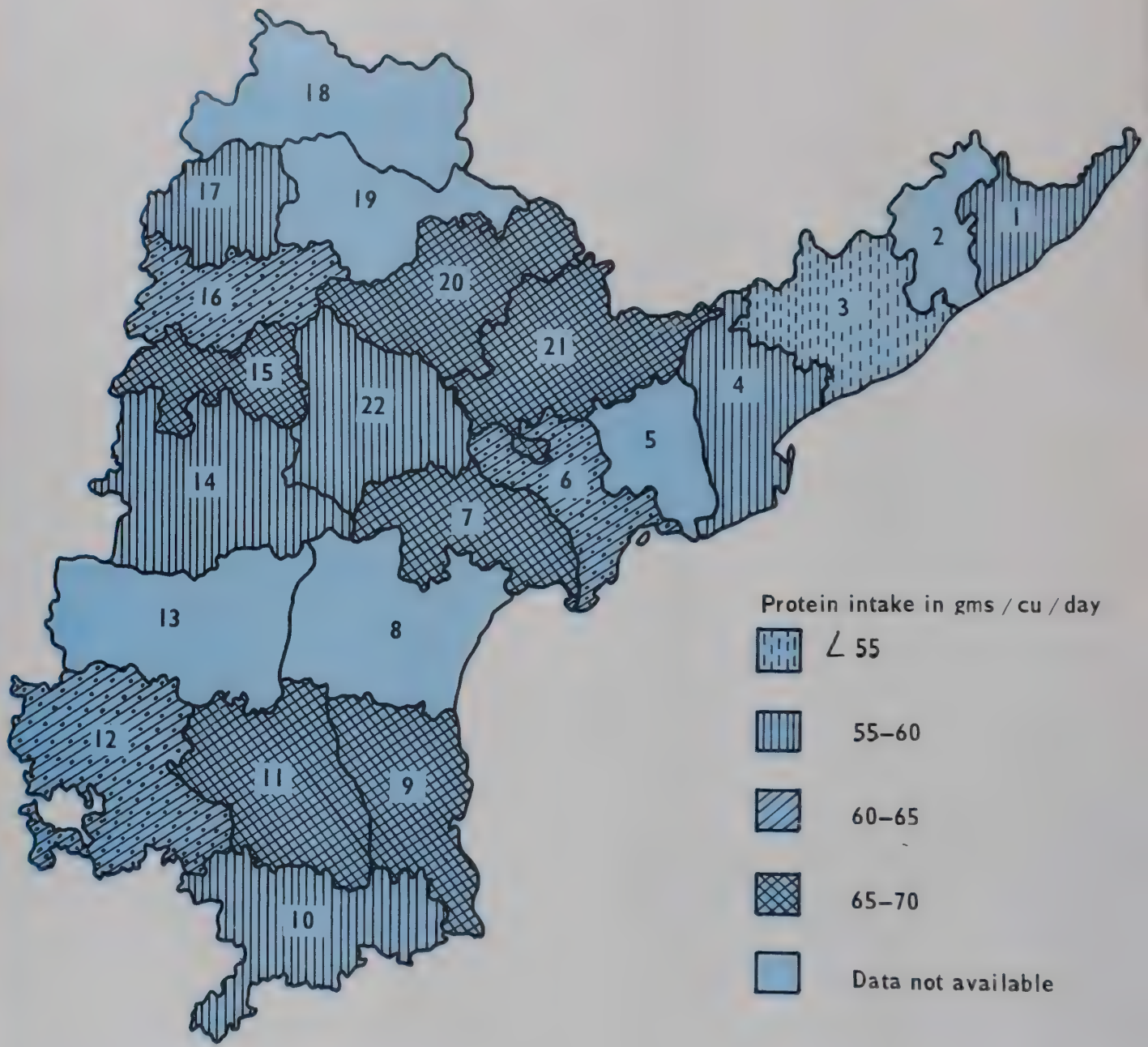
(Source : NNMB Reports, 1975–1981, NIN)



1. Srikakulam 2. Vijayanagaram 3. Visakhapatnam 4. East Godavari 5. West Godavari 6. Krishna 7. Guntur
8. Prakasam 9. Nellore 10. Chittoor 11. Cuddapah 12. Anantapoor 13. Kurnool 14. Mahaboobnagar 15. Hyderabad
16. Medak 17. Nizamabad 18. Adilabad 19. Karimnagar 20. Warangal 21. Khammam 22. Nalgonda.

PERCENTAGE CONSUMPTION OF PROTEINS – RURAL ANDHRA PRADESH

(Source : NNMB Reports, 1975–1981, NIN)



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ary Feeding Programme (ESFP) will be a function of the Technology *times* the Delivery system *times* the Acceptability.

$$E_{SFP} = A \times B \times C \quad \text{or}$$

$$E_{SFP} = (a_1 + a_2) \times (b_1 + b_2 + b_3 + b_4) \times (C)$$

The implications are clear. As any of the factors approaches zero, the effectiveness of the programme also approaches zero. No matter how perfect the blend of supplement from the point of nutrient content may be, if the delivery system is inadequate or food is not acceptable to population due to factors of taste or culture, the effectiveness of the programme approaches zero. Even under conditions of perfect delivery system and universal acceptance of quality food, if the quantity is inadequate for the group, the effectiveness is bound to be sub-optimal.

The current nutrition policy of Government of India, envisages the need to link improved nutrition with health care and a variety of economic and income generating activities. In this context the problem of evaluating the nutrition component in such programmes will be even more complex and exacting. Without proper appraisal of the objectives, the strategies and the relative role set for supplementary feeding it is not prudent to look for only 'nutritional' improvements in 'biological terms'. ***The feeding component which produces beneficial spin offs and helps to achieve non-nutritional goals of a programme deserves due credit.***

There is no dearth of data to prove the point that adequate supplementation through feeding programmes results in improvement of nutritional status of beneficiaries provided the operational efficiency is ensured. The need of the hour is to elucidate the cost effectiveness of such feeding programmes viz-a-vis other alternative strategies rather than impact evaluations. The current programmes and their evaluation can perhaps be reviewed keeping the above equations in mind.

— Dr. N. Prahlad Rao, NIN.

Dear Friend,

Along with the last issue of our bi-monthly *Nutrition News* we had mailed you a proforma for a Readership Profile Survey.

A large number of you have responded most enthusiastically. We thank you all. Apart from many kudos we are receiving several worthy, implementable suggestions. We shall surely try and incorporate as many of them as possible

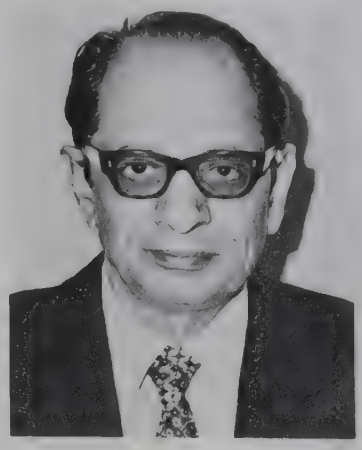
Some readers have not yet mailed us the profile. We are sure that almost all of you have the intention and inclination to reply but are constrained in several ways. Please do spare a little of your valuable time and mailus the filled-in profile, if you have not yet done so. Your feedback is surely going to help us in designing and producing an even more informative nutrition news.

— Editors

INSTITUTE NEWS

Dr. P.G. Tulpule, M.Sc., Ph.D., Director, NIN, retires from service after a distinguished career with the Institute for about 36 years.

Purushottam Gopal Tulpule joined the Nutrition Research Laboratories at Coonoor in 1947 as a Parlakimedi Research Scholar. He worked as a Post-Doctoral Fellow at University of Wisconsin, Madison, USA, under the Fulbright programme. A diligent worker, he rose from the ranks to become the Deputy Director and Head of Toxicology Division at the Institute in 1971. Later in 1976 when the ICMR established the Food and Drug Toxicology Research Centre at NIN, Hyderabad, Dr. Tulpule was appointed as its Officer-in-charge, From June 1980 to June 1983 he has been the Director of NIN.



The main areas of his interest have been nutritional biochemistry and food toxicology. He has published over 80 original research papers on these subjects. The topics of his research include metabolism of proteins, vitamins and essential fatty acids, PEM and vitamin deficiencies.

In recent years he has been very much involved in work on Mycotoxins especially Aflatoxins. He is co-author of a monograph entitled 'Health hazards of mycotoxins in India'. Dr. Tulpule who is a member of many learned scientific societies and committees has guided several students to obtain their doctorate degrees in Biochemistry.

During his tenure as Director, Dr. Tulpule has given a new orientation to NIN's functions. Under his guidance studies on several collaborative projects were carried out at the Institute. Emphasis has been also on providing consultancy and evaluation services to Governments and International agencies.

TRAINING COURSES

Regular Course

The Twelfth Annual Training Course on Endocrinological Techniques and their Applications will be held at the Institute. About seven participants from different parts of India are expected to attend. (8 August – 23 September).

Panel Discussion

As part of the Sixth Annual Certificate Course in Human Nutrition for Teachers from Agricultural Universities and Sixteenth M.Sc. (Applied Nutrition) Course, a panel discussion on ***Nutrition Extension*** will be held in July 1983.

Dr. C. Prasad, Asst. Director-General, ICAR, New Delhi,
Dr. P. Pushpamma, Dean, Faculty of Home Science, APAU.

Hyderabad, Dr. Arun K. Gupta, Director, Model Institute of Education & Research, Jammu and Dr. M. Mohan Ram, Deputy Director, NIN, Hyderabad will lead the discussions.

Ad-hoc Programmes

Mr. Soemanto and Mr. Paternus Purba, WHO Fellows from Indonesia will be at the Institute for a month between 4–30 July 1983 for training in implementation of nutrition education programmes.

Dr. (Mrs) Sushila Bali, RFWMO & E Region, Purv Kaman Mukhyalaya, HQ Eastern Command, Calcutta will be at the Institute for an Orientation to Nutrition in the areas of Dietetics in supplementation, nutrition extension, communication, community participation; management and evaluation primary health care. (28 July – 7 August).

RESEARCH NOTES

ORS AND BACTERIAL CONTAMINATION

Oral rehydration solution (ORS) is now recognised as the treatment for dehydration resulting from diarrhoea in children and infants. The WHO has recommended that ORS should be prepared using potable water and the fluid should be consumed within 24 hours of preparation.

In our rural communities, well water is the major source for drinking water. Analyses of water samples from several villages near Hyderabad showed fecal pollution. This indicates that rural children are ingesting a large number of bacteria through drinking water even under normal conditions. Since the same water is used for preparing ORS, the children fed ORS may be exposed to a greater risk. It was observed that bacterial contents were several fold higher in ORS than in water indicating that glucose and salts promote rapid growth of organisms. When ORS was prepared with boiled water, bacterial counts were significantly lower as compared to ORS made with plain well water. However, significant bacterial growth was noted in ORS after 12 hrs. of preparation irrespective of whether boiled or plain water was used.

The implications of these findings are : (i) boiled water should be used for preparing ORS (ii) the fluid should be used within 12 hours of preparation.

Usually ORS is supplied as 1 litre packets. But most children in the community have mild or moderate diarrhoea and consume less than 1 litre of solution in a day. Giving them 1/2 litre packets seems to be more practical. The fluid can then be consumed within 12 hours avoiding wastage as well as contamination. Doubts have been expressed regarding the feasibility of using boiled water in rural homes because of difficulties like high cost of fuel etc. However in the present study, 70% of the rural women used boiled water for making ORS as per instructions. [illegible] a general belief in this region that if plain water is g[illegible]n to an infant with diarrhoea it may develop cold. Thus, mothers were receptive to be idea of using boiled water for preparing ORS.

As a practical measure, along with intervention education taking advantage of such local beliefs, may prove to be highly successful.

MENARCHE AND GROWTH SPURT IN URBAN HYDERABAD GIRLS

Reports from developed countries have indicated a secular trend towards a decline in age at menarche. But not much information on this aspect in developing countries is available. Such an information is of importance especially in the Indian context where early marriages and teenage pregnancies are more common in poor income groups. About 700 urban school girls of Hyderabad between 9–16 years of age from middle and upper income groups were surveyed.

The mean age at menarche was found to be 12.4 years in this group. All the girls had reached menarche by 15th year. Earlier nationwide ICMR studies had reported the age at menarche for AP girls to be 13.1 years. The present data definitely indicates a decline in the age at menarche of urban Hyderabad girls. Various socioeconomic indices like education, occupation, income and family size did not show any influence on the mean age at menarche.

In the age group 11–14, girls who had attained menarche were taller than the girls who had not attained menarche. After the age of 14, the heights of all the girls were similar irrespective of whether they had attained menarche or not.

Thus girls who attained menarche before the age of 14 had an early growth spurt. But after age 14, growth spurt was attained irrespective of the menarchal status. The mean weight of the girls ranged from 37–42 kgs. The mean weight as well as weight for height was not significantly different between girls who had attained menarche and those who had not. About one third of the girls who had attained menarche were below 75% of the reference weight. These data seem to indicate that girls need not attain a critical weight before attaining menarche. Also factors other than nutrition seem to have an equal role in deciding age at menarche and growth spurt.

A survey of about 100 girls from urban slums of Hyderabad also indicated similar trends (Average age at menarche for these girls was 12.6 years). Perhaps exposure to psychosocial stimulation through modern media influences neuroendocrine secretions and results in early growth spurt and menarche in urban girls. The situation in rural population remains to be studied.

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170
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NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL. 4. No. 5. SEPT 1983

CURRENT TOPIC

DRUG UTILISATION – PERCEPTS AND PRACTICES

Drugs have been of importance to physicians and patients from times immemorial. Medicaments have evolved from simple herbal preparations to most modern synthetic drugs. The number of drugs available and used today has reached very large proportions. Every medicament is potentially hazardous. The thalidomide tragedy which caused congenital abnormalities and more recently problems with practolol have awakened the medical profession and the public alike. It is important that every one should be aware of the risks and benefits of therapeutic agents and use them discriminately. Drug utilisation is defined by WHO as *'The marketing, distribution, prescription and use of drugs in a society with special emphasis on the resulting medical, social and economic consequences'*.

According to the Drug and Cosmetic Act of India, several pharmaceutical preparations are listed in schedules such as 'L' and 'H'. Drugs under these schedules should not be consumed without proper medical supervision. Hence, no pharmacist should dispense these scheduled drugs unless it is prescribed by a registered medical practitioner. These schedule drugs or prescription drugs are generally associated with some major disadvantages along with advantages.

The non-prescription drugs are usually sold over the counter even without proper medical advice. Such drugs are often advertised over the media to the general public also. These are known as over the counter sales drugs or OTCs. OTCs are less dangerous if used prudently.

NIN has earlier demonstrated that pharmacokinetics of drugs are altered by malnutrition. In view of this, it was considered necessary to collect information on drug consumption pattern in the population.

Since consumer collection of drugs across the counter is perhaps an accurate source of information about drugs that are prescribed/purchased for consumption, a survey on this aspect was conducted with cooperation of the Directorate of Drug Control Administration and A.P. Chemists and Druggists Association, Hyderabad. The study envisaged to collect information on drug consumption pattern in the twin cities of Hyderabad and Secunderabad which have a population around 2.5 million and are served by 330 retail pharmaceutical shops.

This study covered 10% of pharmaceutical shops registered in the twin cities. Trained investigators were employed to note down the particulars of drugs in a pre-tested schedule. In a period of 4 months, activity of each druggist was covered for 4 complete days. The data collected was analysed for various details. In total 26.288 sales containing 44.889 drugs were monitored. The surveillance has brought out the current practices and certain disquieting factors which need to be viewed with discretion.

Physicians prescribing habits and self administration of drugs have been evaluated. Only 61% of doctors have indicated their names and 48% have given their affiliations. It is alarming to observe that self medication rate is as high as 46%. The rate of pharmacists' prescriptions on the other hand is negligible (1.8%). However, it is comforting to observe that the mean number of drugs per prescription is quite small (around three) both on doctors advice and self help. Only in 4.3% of doctors prescriptions, the number of drugs exceed 4 and in 27% it was between 3 and 4.

Most of the prescriptions were by general practitioners. Obviously the population which is buying medicines is capable of consulting private doctors. Only around 8% had consulted hospital doctors. Hospital prescriptions probably are being dispensed in the hospital pharmacy itself.

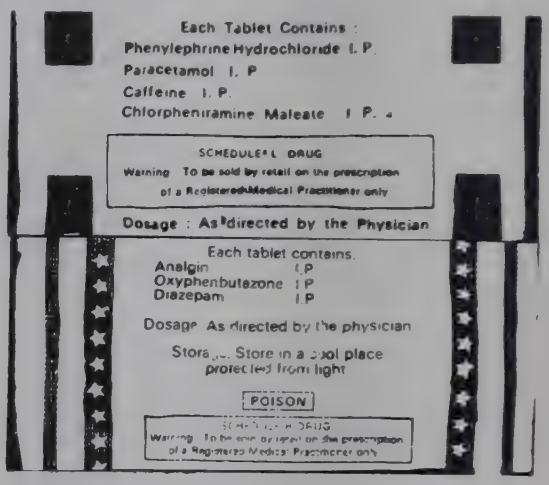
It is important to realise that the prescription order is a therapeutic transaction between the patient and doctor which needs to be clear and explicit. But unfortunately, majority of doctors' prescriptions do not contain details about patients such as name,

age, sex, provisional diagnosis and dosage schedules with duration of therapy. The patient needs to be thoroughly instructed as to the manner of using the medications, the amount of medication, frequency, duration and timing of the dosage. Though the doctors might have delivered oral instructions, it is necessary to document it on the prescription order. Unfortunately, most of the prescriptions were incomplete.

It was observed that nutritional products (tonics, enzymatic preparations & vitamins) topped the list among doctors' prescriptions; whereas analgesics were first among self administered drugs. Next in order, doctors have prescribed anti-infectives (antibiotics and sulfa) and analgesics, whereas in self medication, nutritional products and antibiotics occupied the second and third place. The percentage of prescriptions containing these products were found to follow the same order. It was further observed that drugs such as hormones (corticosteroids), hypoglycemic agents, cardiovascular drugs, drugs used for respiratory, gastro-intestinal disorders and sedatives and tranquilizers were bought by the public without proper medical advice.

It is true that all the nutritional products are considered to be OTC drugs. Vitamins and tonics are being widely advertised and sold; they account for 15% of the total drug production cost in India but are perhaps being misutilised both by doctors and public. Earlier questionnaire surveys by NIN also indicated that only 31% persons had correct concept regarding vitamins/mineral supplements. Majority have an erroneous view that daily consumption of such "tonics" is essential for health. The community is obviously consuming such formulations possibly under the influence of advertisements as well as doctors' advice. It is necessary to remember that nutrition cannot be built across the pharmacy counter and it cannot be an alternative to nutritious food. It is ironic that the public should be spending money on products which can be more easily obtained at less cost through a balanced diet. Infact a considerable proportion of practitioners (16%) themselves have prescribed more than one vitamin preparation each having the same ingredients in various dosage forms for simultaneous use! The sales of nutritional products are not at all in keeping with the prevalence of the disorders among this segment of the population. Combinations of vitamin B-complex containing B_1, B_2, B_6, B_{12} and other vitamins rank first among sales, whereas vitamin B_2 deficiency and iron deficiency anaemia are more often encounted in the population. Excessive and indiscriminate use of certain vitamins can be associated with toxicity. Moreover in a poor country like ours unnecessary medication with vitamins needs to be curtailed. Vitamins also should be considered as drugs and proper control measures are required to channelise their use.

The dawn of modern medicaments has brought in its wake a number of problems of which self medication assumes significance. Self medication is probably an alternative to consulting a doctor. The profile of drugs which have been purchased by patients on their own are similar to that of drugs prescribed by a doctor. It is surprising to note that even medicaments which are strictly indicated for certain types of diseases are being purchased without the experts' advice. Among the self medicated drugs 58% belong to the scheduled category.


Each Tablet Contains :
Phenylephrine Hydrochloride I. P.
Paracetamol I. P
Caffeine I. P.
Chlorpheniramine Maleate I P.
SCHEDULE 'L' DRUG
Warning To be sold by retail on the prescription of a Registered Medical Practitioner only
Dosage : As directed by the Physician
Each tablet contains.
Analgin I.P
Oxyphenbutazone I P
Diazepam I P
Dosage As directed by the physician
Store in a cool place protected from light
POISON

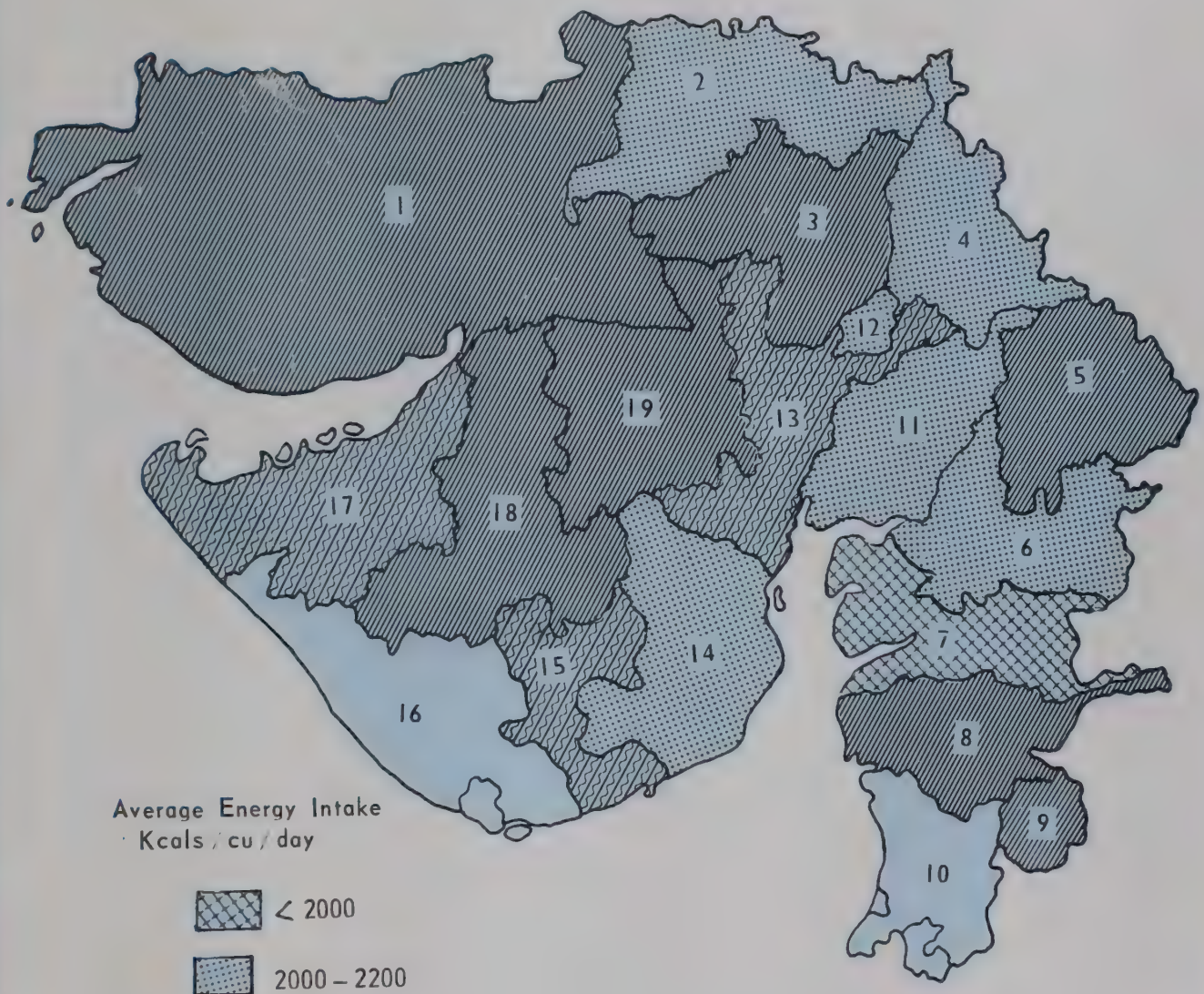
The large scale consumption of analgesics is a universal phenomenon. Even among self prescribed analgesics / antipyretics & antiinflammatory agents 30.2% are scheduled drugs which need a prescription. These include Analgin, Phenylbutazone with or without corticosteroids, propoxyphene and Ibruprofen. Analgin is a potent sulfonated aminopyrine classified as schedule 'H'. Even though the incidence of bone marrow depression associated with such drugs may be low (0.01 to 0.8%), there are other complications which need medical attention. Analgesics require to be used more judiciously in the present practice of internal medicine.

Even potent antibiotics in inadequate doses have been purchased without prescriptions. Corticosteroids (apart from topical preparations) have also been purchased over the counter. Abuse of self medication may surface as a major problem in our society if proper steps are not taken to discourage it. Infact we are not sufficiently informed about the drug abuse phenomenon and we are not even aware of the impact of such practices since facilities for documentation and information processing of adverse drug reactions do not exist here.

It has beeh estimated that antibiotics constitute over 50% of the drug bill in India. The present study indicates that broad spectrum antibiotics are used indiscriminately within the urban area. More than 30% of doctors' prescriptions contain antibiotics and around 12.8% in self medication are for

CONSUMPTION OF CALORIES – RURAL GUJARAT

(Source : NNMB Reports, 1975–1981, NIN)



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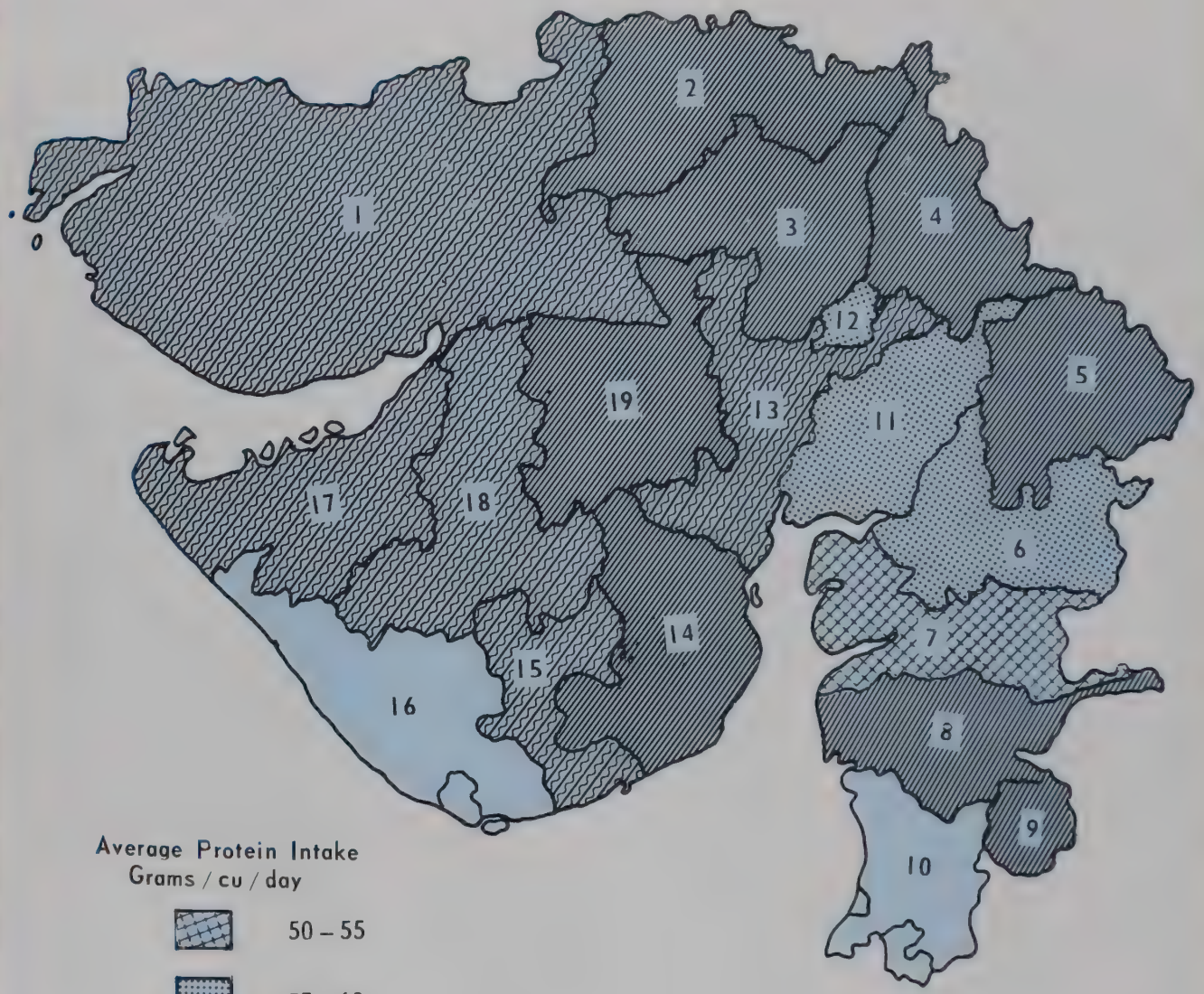
CONSUMPTION OF PROTEINS – RURAL GUJARAT

(Source : NNMB Reports. 1975–1981, NIN)



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antibiotics. We seem to be passing through an era of antibiotics. Doctors preferred to use sulfa and trimethoprim combinations followed by tetracyclines and synthetic penicillins. The self prescribers use more of tetracyclines followed by sulfa and trimethoprim combinations and synthetic penicillins. It is interesting to observe that even among antibiotics self administered antibiotics are similar to those prescribed by practitioners. Obviously the public is adopting an antibiotic mentality similar to that of doctors.

POINTS TO PONDER

Country	Per capita drug consumption	Drug consumption as % of GNP
Developed Nations	15.86 $	0.2 to 1.7
India	1.3 $ (Rs.14/-)	0.92
Rural India	0.03 $ (Rs.0.32)	Not available
Other developing countries	4.18 $	0.1 – 1.1

- 3% of total budget is allocated for health and family welfare in India.
- Expenditure on Drugs:
  Developing countries 40–60% of total health care
  Developed countries 10–20% of total health care
- 20% of the population uses drugs in India (mostly in urban areas).
- India has 5156 licensed drug manufacturers.
- 25,000 different formulations exist in India, where as in developed countries it is below 3000.
- Only around 250 drugs are considered essential by WHO.
- In India roughly 10% of all formulations are vitamins.
- Drug imports for 1980–81 was Rs. 112.8 crores. Most of the imports are life saving drugs. Most vitamins except vitamin A, B and Nicotinic acid amide are still imported.

Top five largest selling drugs in India of one brand (turn over in Rupees Crores).

Sulfa Methaxozale and trimethoprim	11.32
B-complex preparation	7.4
Tetracycline	6.88
Streptomycin	5.82
Analgin	4.63

Quite often the medical profession is blamed for antibiotic abuse. It is difficult to state whether the antibiotic prescriptions are needed since diagnosis has rarely been mentioned in prescriptions surveyed in this study. It is possible that at least in some of them they could have been avoided. What is more relevant and crucial is that most persons have purchased inadequate dosage for a complete course. Among the self medications, 30% purchased antibiotics for less than a day and only 18% purchased it for a full course (five days). Even on a doctors prescription only 40% have purchased antibiotics for a full course (minimum five days). Such practices may have serious repercussions such as emergence of resistant strains, therapeutic failures and unnecessary expenditure. It is important to stress here that misuse of antibiotics and consequent damages are difficult to quantitate. Ignorance and apathy cannot be tolerated in chemotherapeutics. It appears from the study that we may have to look more deeply into our drug utilisation patterns. A concerted effort is required to create a healthy and more viable drug use environment.

The pattern of drug use in any population is going to be determined by the triad namely doctor, patient and pharmacist and interactions within the circle.

It is the moral responsibility of doctors, pharmacists and the public to avoid improper use of drugs. The medical profession needs to be more cautious and discreet in prescribing drugs. It is necessary to document patient details and drug dosage schedules in prescriptions in order to avoid under, over and misusage of medicaments. Instructions to patients need to be explicit. The patient should also protect himself/herself, follow the instructions carefully and avoid self medication with potent drugs. It is necessary to educate the public about abuse of self medication. Indiscriminate use of drugs leads to wastage of resources and generates iatrogenic problems.

The complexity of factors determining the drug use pattern in a community are often ignored. Inadequate availability of health personnel, economic resources and poor education lead to unhealthy drug usage. The average patient is not aware of the potential problems. The pharmacist must have a professional attitude and a sense of responsibility while rendering his services. The pharmacist plays a pivotal role in drug consumption pattern as he is the last man in the therapeutic chain having a direct link with the patient.

It is obvious from the survey that the way in which drugs are used is a cause for concern. The Doctor should be well informed not only about the drugs and their composition, but also have an accurate knowledge of the requirements of the patients; particularly regarding nutritional products and antibiotics. Vitamin B-complex in various combinations and forte preparations are being used without any scientific rationale. Some restrictions on the availability, promotion and sales of medicaments are essential. More stringent laws and regulatory procedures are needed to promote appropriate use of drugs and protect the consumer.

Dr. Kamala Krishnaswamy &
Mr. B. Dinesh Kumar, NIN.

EXTENSION ACTIVITY

Television as an effective medium for communication, is now well recognised. Efforts are being made to expand the Television network to cover more and more areas of the country. As per the recommendations of the working group for preparation of software plan for Doordarshan, a five day orientation workshop in nutrition will be organised at NIN from 24–28 Oct, 1983 for producers from different Kendras. About 25 producers involved in health and nutrition based telecasts are expected to participate. The programme will provide a data base for injecting a nutrition bias in the software component of rural educational TV.

RESEARCH NOTES

Iron Supplementation and Anaemia in Pregnancy

Pregnancy anaemia is a major contributor to high maternal and perinatal mortality in India. In 1970 a National Anaemia Prophylaxis programme was initiated. It envisaged the distribution of folifer tablets (500 µgs of folic acid and 60 mg of iron) to all pregnant women at least during the last trimester.

Upon evaluation, it was found that only 2% beneficiaries were aware of the programme. Awareness among CHVs and Medical Officers was 45%, and that of health visitors and ANMs 100%. Irregular availability of tablets resulted in poor distribution.

A recent hemoglobin survey in the hospital-attending urban slum population indicated that prevalence of anaemia was still as high as what it was 10–15 years ago. Moderate and severe anaemia (i.e. hemoglobin levels below 9 and 7 g/dl) were still as high as 30% and 10%, respectively. Maternal mortality due to anaemia however, showed a reduction from 20% to 8%; probably due to better management by exchange transfusions and parenteral iron therapy.

Analysis of hemoglobin data and prevalence of anaemia revealed that in upper income groups hemoglobin levels were normal, while in the low income groups the levels were low.

Assessment of the folifer distribution programme suggests that for various reasons, a considerable gap exists between the distributors of the tablets and the beneficiaries. To achieve a maximum coverage and reduce the problems in the distribution system, a cafeteria approach which would cover all the women population was suggested. The main objectives of such an approach would be (a) administration of parenteral iron (intramuscular) to all the women having hemoglobin below 9 g/dl irrespective of their pregnancy status, (b) distribution of iron-folate tablets to school age girls to improve their iron stores as a preparation to future pregnancies, (c) to study the feasibility and acceptability of iron-folate supplements given on alternate days or twice a week to normals and mild anemics during pregnancy and ensuring that total amount of iron needed is delivered to such women through CHVs or ANMs, (d) a simultaneous education programme regarding the problems and sequelae of anaemia and to ensure acceptance of the programme.

Health and Nutrition Education in Primary Schools

An investigation was undertaken to study the nutrition knowledge, attitude and practices of teachers and teacher trainees and their approaches to health and nutrition education in selected government primary schools in Hyderabad.

150 primary school teachers in 23 government schools and 130 teacher trainees in Hyderabad, were covered using the questionnaire method. Basics of Health and Nutrition; Food Beliefs; Health and Nutrition Practices and Approaches to Health and Nutrition Education were the four areas of study included in the schedule. Syllabi and text books on Environmental Studies – 2 (Class III-V), Teachers' Hand book (Class I & II) and Teacher Training syllabus were screened for coverage and factual errors, if any.

Though the mean score (for all the 4 areas) of teachers was around 61%, as many as 70% of them were below the cut-off opoint of 50%. The mean score in respect of food beliefs was low (43%). The teachers' responses for individual questions regarding channelisation of health and nutrition education through school health service and programmes such as Mid-Day Meal or School Gardens were also poor. The total and area-wise scores of trainees were lower than those obtained by teachers.

Several lacunae were found in the syllabus and text books on Environmental Studies-2. Some of the basic concepts such as mixed diet, consequences of malnutrition, home production of nutritious foods, did not find a place. The need for revision of books and syllabi for proper coverage of health and nutrition was highlighted. Lack of accommodation, water supply, teaching aids and other physical facilities were found to be the other bottlenecks in the way of effective teaching of health and nutrition.

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NATIONAL INSTITUTE OF NUTRITION

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170
FD-29

CURRENT TOPIC

ORAL REHYDRATION SOLUTION (ORS) AND BACTERIAL CONTAMINATION

Food Science & Technology Information Service
07 DEC 1983
C.F.T.R.I., MYSORE

In the developing countries, two major factors responsible for high childhood morbidity and mortality are diarrhoea and malnutrition. Estimates show that nearly 6 million children in the world die due to diarrhoea every year and of these 1.5 million are from India. The diarrhoeal disease is so rampant primarily due to unsatisfactory environment, lack of potable water and poor personal hygiene. The incidence is particularly high in malnourished children. Severe malnutrition can alter immune status of the child and increase susceptibility to infections. Diarrhoeal episodes in turn affect the nutritional status adversely due to diminished intake of food and malabsorption of nutrients. Thus, the vicious cycle of diarrhoea and malnutrition is perpetuated in poor communities.

Oral Rehydration

The most important complication of diarrhoea is dehydration resulting from loss of water and electrolytes in stool. This is the main cause of death in severe cases. Dehydration can be prevented by early replacement of these losses. Oral rehydration therapy has been shown to be effective in most cases of diarrhoea. ORS packets are being distributed in many areas. Mothers are advised to dissolve the mixture in one litre of water and feed the child at frequent intervals. This simple measure has revolutionised the management of diarrhoeal disease at the community level reducing mortality in children.

Use of Contaminated Water

The WHO recommends that ORS should be prepared with potable water and used within 24 hours. But in most rural areas the only source of water is from the wells which are often contaminated with faecal matter. Can such contaminated water be used to prepare ORS ? It has been stated that the benefits of water and electrolyte replacement in acute diarrhoea far outweigh the possible risk of using contaminated water. However, many people are concerned about the potential of dirty water increasing severity and/or duration of diarrhoea.

Laboratory Experiments

Studies conducted by NIN have shown that water samples obtained from a number of wells were heavily contaminated. When this water was used for preparing ORS, the bacteria multiplied rapidly and after 12 hours of storage the counts were significantly greater in the solution than in plain water. These results indicate that ORS is a good medium for bacterial growth. On the contrary, when well water was boiled and cooled before preparation of the ORS, total bacterial counts were negligible and the presumptive coliforms were also within the acceptable limit initialiy but they increased rapidly after 12 hours. However, even after 24 hours of storage, the bacterial counts were significantly lower in this solution as compared to that prepared from unboiled water. A study reported from Gambia also showed that ORS supports bacterial growth.

Thus a child would receive a greater dose of bacteria through ORS than with plain water.

Based on the earlier studies, WHO scientific working group concluded that E.coli, V.Cholerae, Salmonella and Shigella do not multiply in ORS fluid and survive in declining numbers for upto 48 hours. However, in these studies ORS was made up with distilled water or sterilised surface water and they do not mimic the field conditions. Recent studies have clearly demonstrated that specific pathogens like V. Cholerae, Shigella and Salmonella also multiply in ORS solution prepared with contaminated water. The organic matter in contaminated water supplies the nitrogen source for bacterial growth.

Field Observations

What is the relevance of these laboratory findings to diarrhoeal morbidity in children ? Field studies failed to show any adverse effects of contaminated ORS. There was no difference between children who consumed clean or contaminated solution, with respect to severity and/or duration of diarrhoea. Similar observations have been reported from Gambia and it has been suggested that in children who are exposed to high levels of bacteria in drinking water and food, the additional numbers consumed through dirty ORS may have little effect. However, these are short term studies. The effects of prolonged exposure to such large number of organisms are uncertain.

It has been observed that majority of children in the community have mild or moderate diarrhoea and they consume about 500 ml of ORS, the remaining fluid being discarded. In view of this and the fact that significant bacterial growth occurs after 12 hours of storage, supply of half litre packets appears to be more practical. Mothers can be advised to use the solution within 12 hours avoiding contamination as well as wastage.

The problems of poor environmental sanitation present the rural mother with an impossible dilemma. Since the child with diarrhoea needs replacement of fluid and electrolytes, it would be dangerous to withhold ORS. But by giving contaminated ORS, more infection is introduced into the gut. What is the effect of bacterial pathogens introduced through ORS on an already infected intestine ? What would be its effect in malnourished children ? More field studies are needed to answer these questions.

In conclusion, the laboratory data clearly show that bacteria multiply rapidly in ORS prepared with contaminated water. However, it is not known how this would affect the health of the child. It is safer to boil the water before preparing ORS but this may not be feasible in all circumstances. A sound strategy would be to advise the mothers to use the cleanest water available, boil it where possible and use it within 12 hours.

Dr. Rita Mathur
and
Dr. Vinodini Reddy

RESEARCH NOTES

NUTRITION EDUCATION AMONG INDUSTRIAL WORKERS

A study on the diet and nutrition profile of 385 individuals in 80 families of industrial workers employed in a public sector electronics industry near Hyderabad was undertaken. The nutritional status of the study population was found to be lower compared to that of well-to-do Indian subjects though no frank nutritional disorders were observed in the present sample.

A planned programme of nutrition education was undertaken, taking into account baseline information on nutritional status of the subjects, usage of different foodstuffs and family expenditure. The education campaign consisted of distribution of specially prepared short pamphlets on different aspects of nutrition such as mixed diet, diet during illness, low cost nutritious food, periodic health check-up etc. In addition, oral explanation of certain essential aspects was

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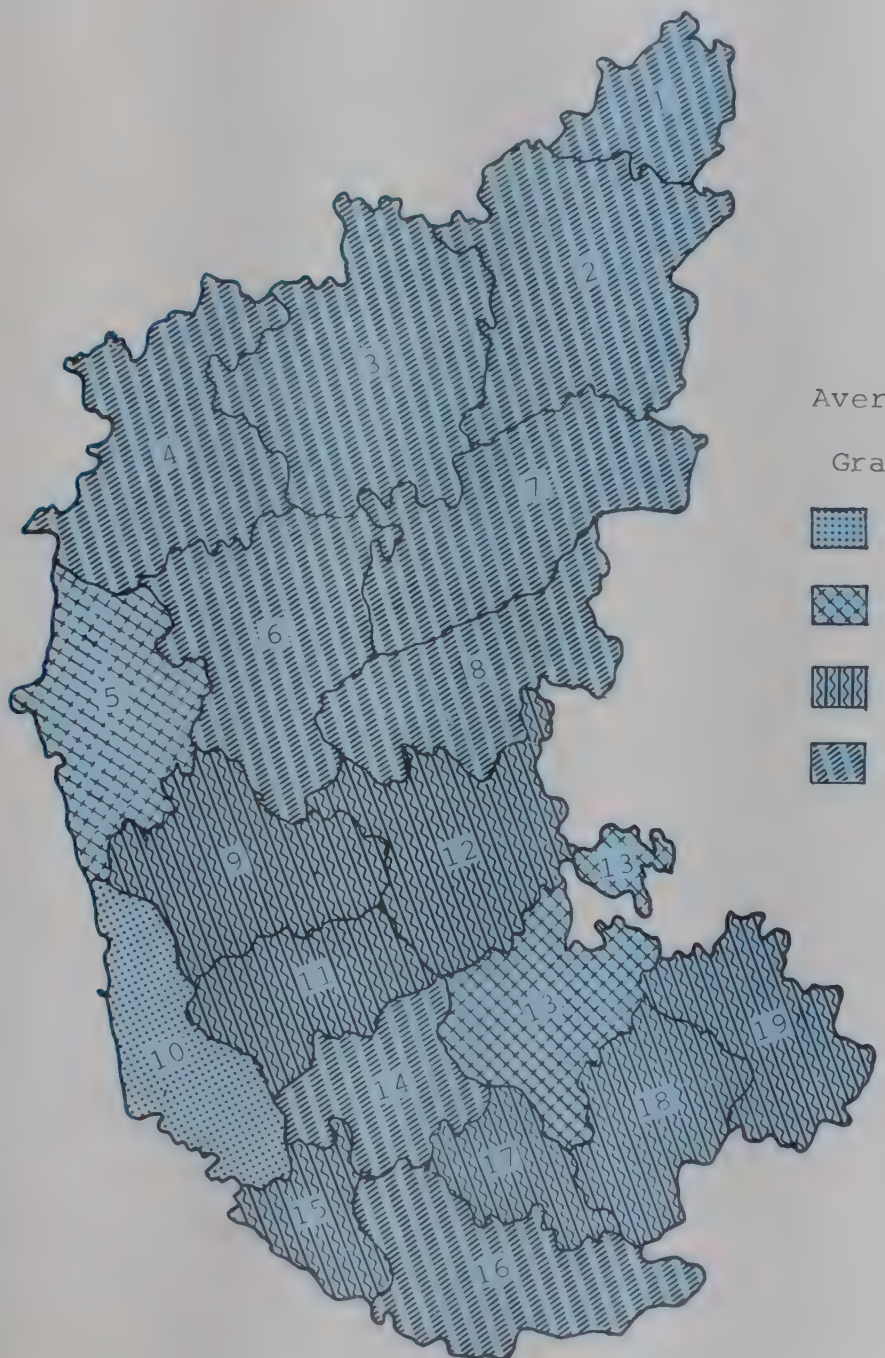
(Source: NNMB Reports, 1975-1981, NIN)



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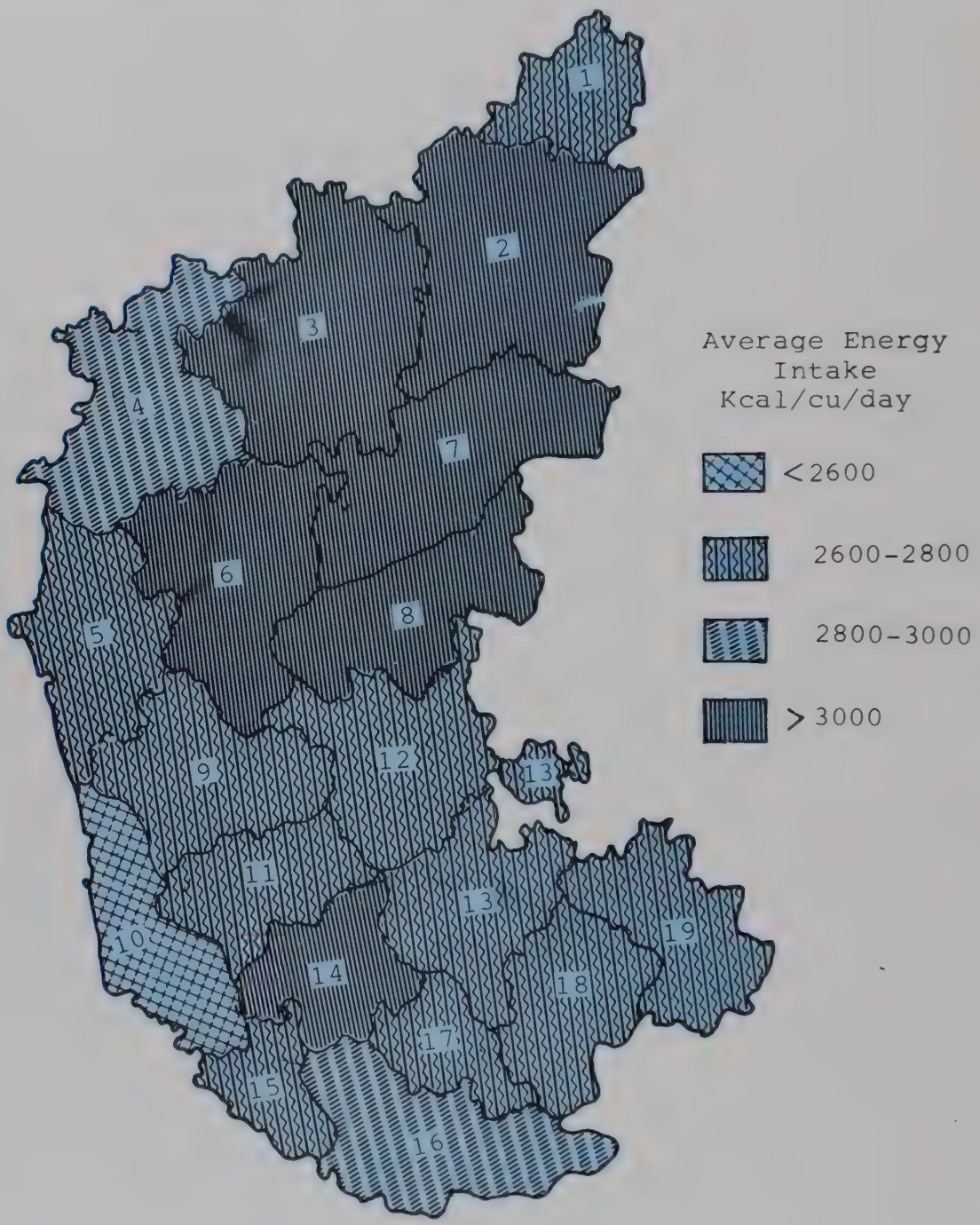
11. Chikmagalur 12. Chitradurga 13. Tumkur 14. Hassan 15. Coorg
16. Mysore 17. Mandya 18. Bangalore 19. Kolar

CONSUMPTION OF CALORIES - RURAL KARNATAKA
(Source: NNMB Reports, 1975-1981, NIN)



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16.Mysore 17.Mandya 18.Bangalore 19.Kolar

undertaken during home visits. Families were divided into lower income (I) or higher income (II) groups, based on total income.

That the respondents were receptive to nutrition education was evident from desirable alterations in diet and higher scores for awareness of health/nutrition concepts in the post-education period. 20.5% of families in Group I and 29% in Group II showed significant increases in frequency of pulse intake. The figures were 42% and 79% for greens, 41% and 34.5% for common fruits and 32.5% and 68% for flesh foods, with only a marginal increase in total food expenditure.

Percentages of families in the two groups obtaining more than 50% scores for recall of educational informationin the areas 'Mixed Diet', 'Home Production of Nutritious Foods' and 'Health Care' were respectively : 42.5%(I), 55% (II); 80% (I), 72.4% (II) and 65% (I), 72% (II).

More comprehensive health/nutrition education efforts are called for among workers in lower wage brackets, using industrial canteens as vehicle and venue for such campaigns.

NUTRITIONAL QUALITY OF AMARANTHUS GRAINS

Grain amaranths are fast growing tropical plants which produce abundant cereal-like grains. They have a promising economic value. In early years they were principal food crops for the Americans. These grains are now cultivated mostly in the Central and Southern Americas, Mexico and hilly areas of Asia and Africa. The grain amaranths are grown in India mainly in the Sub-Himalayan ranges and the Nilgiris. They are known locally as raj keera or ramdana.

Several strains of amaranths viz., Amaranthus Cruentus and Amaranthus Hypochondriacus were analyzed for their nutrient composition and amino acid content. Market samples were evaluated for protein quality and supplementary effect on wheat proteins.

Nutritive value of market samples of grain Amaranthus per 100 g.

Protein	15.6 g.
Fat	6.3 g.
Crude fibre	2.4 g.
Calcium	222 mg.
Iron	13.9 mg.
Phosphorus	548 mg.
Niacin	0.75 mg.

The net protein ratio (NPR) and relative net protein ratio (RNPR) were determined in groups of young, weanling, male albino rats, fed grain amaranth alone (8.5 % protein), wheat + amaranth (6:3 protein ratio); wheat + amaranth + skimmed milk powder (5:3:1 protein ratio) and amaranth + 1% DL–methionine.

Compositional studies showed that, as compared to common cereal grains such as wheat, grain amaranths had higher content of protein (14.5 – 17.9%), lysine (4.7 – 5.8 g/16 gN), and calcium (197 – 389 mg/100 g) but had lower content of nicotinic acid (0.68 – 0.94/mg/100 g.).

The NPR of grain amaranth (3.82) was significantly higher than that of wheat (2.68). Supplementation with amaranth protein significantly enhanced the NPR of wheat protein. The addition of skimmed milk powder further increased the NPR of wheat and amaranth mixture to a level equal to that of amaranth protein, but not to the level of casein. The addition of 1% DL–methionine had no supplementary effect on amaranth protein.

Thus a superior nutritional quality of amaranth protein per se, and its supplementary effect on wheat protein have been demonstrated.

WORKSHOP

Mr. P. Badhravata, Director, Doordarshan Kendra, Hyderabad, inaugurated on 24th October 1983, a five-day Nutrition Orientation Workshop

for TV Producers. Ten producers involved in developing telecasts based on health, hygiene, nutrition and family welfare themes were deputed from Calcutta, Cuttack, Delhi, Hyderabad, Jullundur, Madras and Srinagar, for the workshop.

This workshop programme was so designed as to provide the producers an exposure to different aspects of nutrition. They had opportunity to see clinical cases of malnutrition and observe measures for their rehabilitation. Visit to rural centres helped the participants in gaining an insight into the extensive nature of the nutrition problems and to appreciate the various environmental factors influencing nutrition status. In their talks, faculty members highlighted the sequelae of malnutrition during crucial periods, namely, infancy, childhood, pregnancy and lactation.

Participants were provided uptodate information relating to various nutrition programmes in operation and bottlenecks hampering their proper implementation and impact. In addition, aspects relating to balanced diet, choice of foods, measures for ensuring minimum nutrition losses from foods and practical steps for ensuring food safety were also covered.

Discussions revealed that there was much scope for strengthening the TV coverage on matters relating to food, nutrition and health. It was felt that packing the programmes with too much of information was not desirable from the point of view of the comprehension of target viewers. On the other hand, it is preferable to produce telecasts with a built-in human interest value concentrating on a core message. A wide range of formats - including dramatisation, folklore, demonstration and testimonial type of approaches could be adopted leading to diversification. Discussions also brought to light the need for strengthening the education component of the various on-going community nutrition programmes and the cardinal role of TV in this regard.

A list of topics covering maternal and child health and nutrition were identified for production at the different centres. A set of quickies with core messages is also planned to be telecast. It was agreed that backgrounders containing scientific information on these various topics will be provided by NIN along with visuals as well as other shooting facilities.

Participants opined that such workshops were very useful in equipping them with authentic scientific information for producing health/family welfare telecasts. They, however, felt that relevance and usefulness of these workshops would be enhanced if the coverage of topics was more intensive. An increased duration with sufficient scope for practical work and group evaluation was favoured.

TRAINING PROGRAMME

The Twentyfirst Annual Certificate Course in Nutrition of 3 months duration will commence from 1st December 1983. Participants in the course are senior teachers in medical colleges or public health personnel involved in implementation of public health nutrition programmes. Seventeen participants from different States of India including two sponsored by defence services are expected to participate.

Editor : Dr. M. Mohan Ram; Assistant Editor : V. Ramadas Murthy
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170
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NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL.5 NO.1 JANUARY 1984

CURRENT TOPIC

IS CARNITINE AN ESSENTIAL NUTRIENT?

In the jargon of nutritionists, a substance which the body needs, but cannot synthesize, is termed 'essential'. Thus while both essential and nonessential amino acids are needed for synthesis of tissue proteins, the former must be supplied through diet, whereas the latter can be synthesized by the body provided other building blocks are present. It is something like imported vs. indigenous technology.

Vitamins, as a class of compounds are categorised as essential nutrients. Body's requirement for vitamins is minute compared to nutrients like sugars, proteins and fats and hence vitamins fall under the classification of micronutrients. Certain substances are termed essential even though they can be synthesized in the body, because their precursor or the parent compound has to be supplied through diet. For example, vitamin A can be synthesized by the body from the plant pigment β - carotene. Similarly, B-vitamin niacin can be synthesized from an essential amino acid called tryptophan. Vitamin A and niacin requirements thus can be partially or fully met through dietary β - carotene and tryptophan respectively.

Generally, if living organisms are deprived of an essential nutrient (or its precursor), their growth is affected. Growth is therefore an important yardstick for ascertaining the essentiality of a nutrient.

THE CARNITINE STORY

Carnitine was isolated from meat in 1905 and its chemical nature as β - hydroxy, γ - butyrobetaine elucidated 25 years later. Most foods contain carnitine in small amounts. High concentrations are however found in meat. In 1905, Frankel & co-workers observed that the yellow meal worm Tenebrio mollitor needs carnitine for growth and called carnitine vitamin Bt. Subsequently, a few more organisms were found to need this substance for growth. Till recently, however, carnitine deficiency in animals or man was not recognized.

In 1955, Friedman, Frankel & Bhattacharya showed that carnitine helps in transport of fatty acids into the mitochondria when they are burnt to yield energy. Carnitine acquired an important place amongst the class of compounds called 'biochemical cofactors' (factors that assist in metabolism) - a role akin to that of vitamins.

Carnitine which occurs widely is vital to the living organism. The fact that deficiency of carnitine cannot be demonstrated in higher organisms suggested that it can be synthesized in the body. The question was how? After many years of frustrating research, Broquist & colleagues at Vanderbilt University found in 1971 that the amino acid lysine is the parent compound (precursor) of carnitine. Essential amino acids lysine and methionine and some other essential nutrients such as iron, vitamin C & B_6 are also required for the conversion of lysine to carnitine. These findings kindled the interest of nutritionists like us in carnitine.

The work done by Latifa Khan - Siddiqui and the author at the National Institute of Nutrition shows that protein energy malnutrition in adults and children lowers serum carnitine levels. Malnutrition due to Schistosomiasis infection in Egypt has been reported to have a similar effect. However, serum carnitine levels in apparently healthy men of low income and high income groups were found to be

comparable, though the former consumed significantly lower amounts of carnitine and lysine from their cereal-based diets than the latter. From this it was inferred that intake of predominantly cereal based diets by the poor Indians, does not lead to carnitine deficiency assuming that serum carnitine is an index of carnitine status of the body. Subsequent experiments in humans showed that this trend may be partly due to the low fat intake in the low income group population. Since carnitine is needed for fat metabolism, low fat diet had a carnitine sparing action. Hypothetically therefore, carnitine deficiency may develop in these subjects, if their fat intake were to rise without a corresponding increase in lysine or carnitine.

Experiments in rats done by us and those reported from Broquist's laboratory suggest that plasma carnitine levels do reflect the carnitine economy of the body. Thus rats fed wheat or rice diet have lower levels of serum and muscle carnitine, than animals fed casein diet. Fat metabolism is concomitantly reduced and fat levels in tissues increase.

Supplementation of wheat diet with carnitine raised tissue carnitine levels, improved fat metabolism and cleared the tissues of extra fat, but did not improve growth unless lysine and threonine were added to the diet. Absence of growth promoting effect of carnitine in lysine deficient (cereal diet fed) rats is understandable. Because in the absence of lysine, the crucial building block, carnitine cannot improve growth.

Extrapolating from this rat study, we speculated that carnitine deficiency may at least partly be responsible for the fatty liver in kwashiorkor - a clinical manifestation of protein energy malnutrition in children.

Vitamin C deficiency in guinea pigs has been reported to produce carnitine deficiency. Development of fatty heart in diphtheria toxin treated guinea pigs has been found to be due to low carnitine levels in heart. In the past 10 years, numerous case reports of genetic defects leading to carnitine deficiency have been reported in humans. These patients have low levels of serum and muscle carnitine (systemic deficiency) or only muscle carnitine deficiency. Associated fat accumulation in muscle leads to muscular dystrophy.

In the rat, carnitine can be synthesized only in the liver, but in monkeys and humans, liver and kidneys can synthesize carnitine. Carnitine deficiency has been reported in patients suffering from liver diseases and those undergoing dialysis for kidney ailments. Sudden death in patients undergoing kidney dialysis is attributed to fall in heart carnitine. In fact in the U.S. there is a move to add carnitine to dialysis fluid.

In rats, lysine is first incorporated into protein, then methylated and liberated as trimethyl lysine (TML). This is the precursor of carnitine. Work done at NIN suggests that humans may have an alternative rapid pathway for synthesis of carnitine. Thus when oral lysine was administered to healthy males, there was a rise in serum and urinary carnitine within 3-6 hours. Such a rise would be difficult to explain from the slow pathway via proteins described in rats. Mal-

THE CENTRE-SPREAD (Data given in the centrespread pertain to consumption of calories and proteins/cu/day in the State of Kerala)

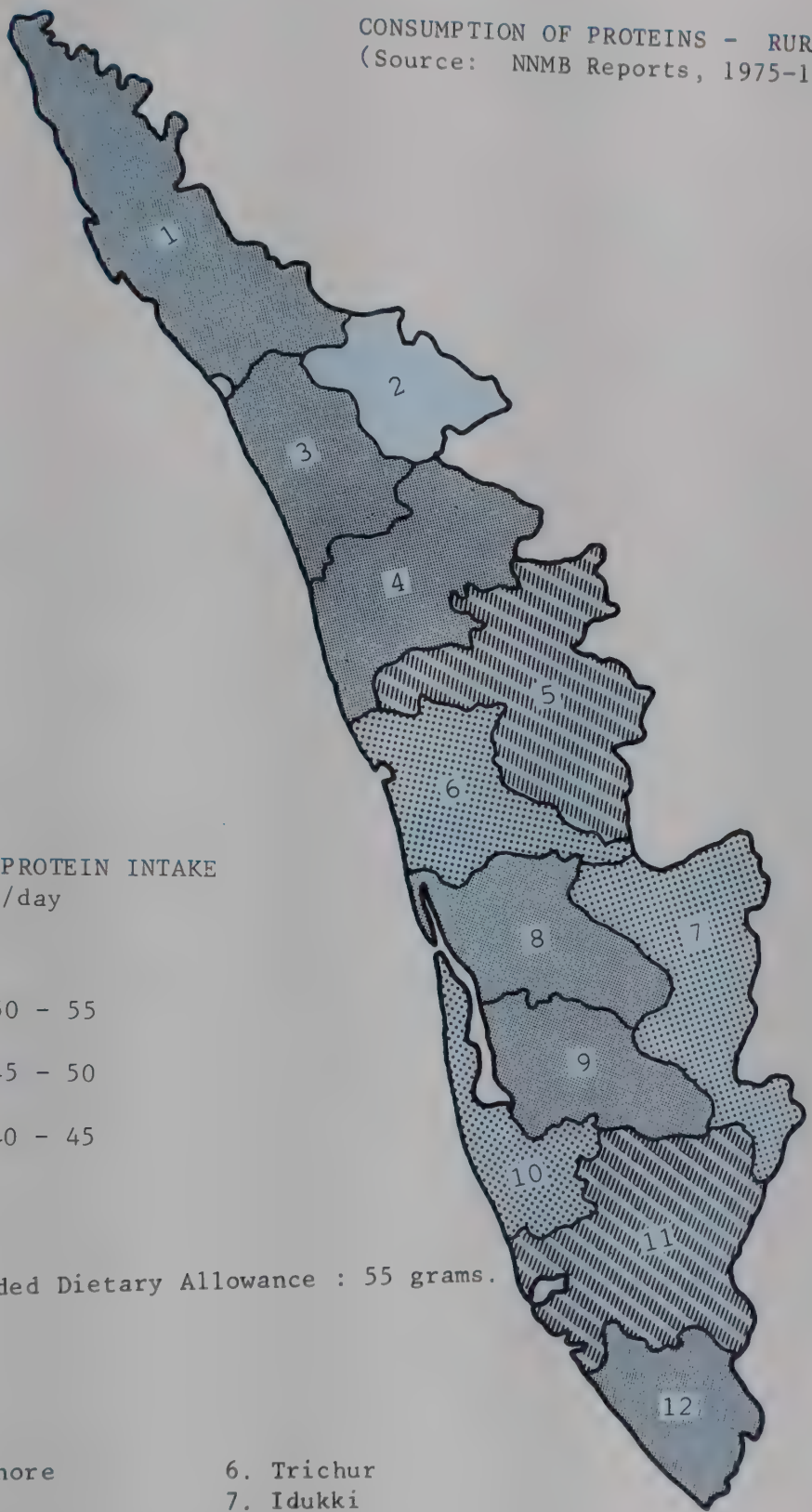
Calories :	District Nos.
Adequate ($\geqslant$ 2400 Kcals)	-
Marginally Adequate (2000 - 2400 Kcals)	3,5,7,9,10,11
Not Adequate ($<$ 2000 Kcals)	1,4,6,8,12
Proteins :	
Adequate ($\geq$ 55 g)	-
Marginally Adequate (45 - 55 g.)	5,6,7,10, 11
Not Adequate ($<$ 45 g.)	1,3,4,8,9,12

Data presented here are based on the latest average figures reported by the National Nutrition Monitoring Bureau (NNMB) in their district-wise surveys carried out in the State.

Cut off levels are arbitrary.

NOTE: Wynad district was formed subse-

CONSUMPTION OF PROTEINS - RURAL KERALA
(Source: NNMB Reports, 1975-1981, NIN)



AVERAGE PROTEIN INTAKE
Grams/cu/day

50 - 55

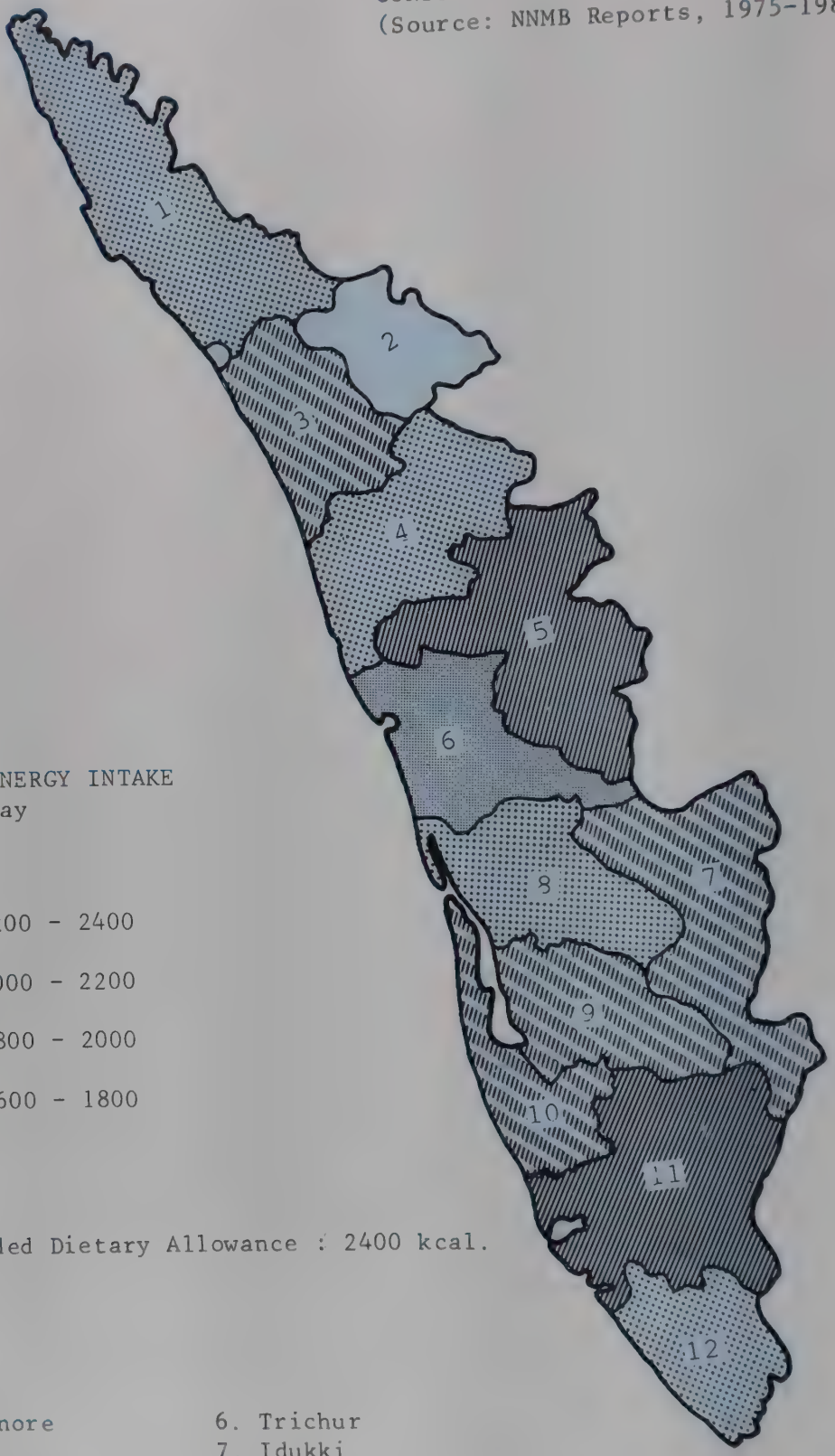
45 - 50

40 - 45

Recommended Dietary Allowance : 55 grams.

1. Cannanore
2. Wynad
3. Kozhikode
4. Malappuram
5. Palghat
6. Trichur
7. Idukki
8. Ernakulam
9. Kottayam
10. Alleppey
11. Quilon
12. Trivandrum

CONSUMPTION OF CALORIES - RURAL KERALA
(Source: NNMB Reports, 1975-1981, NIN)



AVERAGE ENERGY INTAKE
Kcal/cu/day

- 2200 - 2400
- 2000 - 2200
- 1800 - 2000
- 1600 - 1800

Recommended Dietary Allowance : 2400 kcal.

1. Cannanore
2. Wynad
3. Kozhikode
4. Malappuram
5. Palghat
6. Trichur
7. Idukki
8. Ernakulam
9. Kottayam
10. Alleppey
11. Quilon
12. Trivandrum

nourished subjects did not show the rise in serum carnitine after lysine load indicating the possibility that malnutrition may adversely affect carnitine synthesis by the body. These observations and inferences however need to be confirmed and extended.

In summary, work done at NIN and elsewhere suggests that carnitine should be regarded as an essential nutrient, since it is formed in the body from the essential amino acid lysine; and it is a vital compound and its deficiency can be demonstrated in marked protein energy malnutrition and vitamin C deficiency. Carnitine deficiency is however not widespread because dietary situations that limit carnitine availability, also reduce its requirement.

- Mahtab S. Bamji.

WORKSHOP

NUTRITION IN PRIMARY HEALTH CARE

Seven delegates from Health and Family Welfare Training Centres of Maharashtra, Tamil Nadu, Orissa, West Bengal and Nagaland participated in a Workshop on 'Nutrition in Primary Health Care' held at the National Institute of Nutrition, between 20-23 December 1983. This Workshop was supported by World Health Organization as part of the Institute's training programmes in nutrition. The following points emerged from the discussion:

1. In order to strengthen the nutrition component of the primary health care services, at least about 10% of the total training period of the peripheral workers will have to be devoted to the subject of nutrition. The training should be more field oriented and task oriented rather than the class room type. As far as possible, training must incorporate the role of nutrition along with other core health problems.

2. The need for continuing education of the functionaries at the peripheral level was highlighted. In this connection, it was recommended that District Training Teams on the lines being planned in Maharashtra be started in different states.

3 It was suggested that nutrition education on key issues like breastfeeding, introduction of weaning foods, diet of pregnant and lactating women and prophylaxis programme against vitamin A deficiency and anaemia etc., can be strengthened. However, the workshop felt that the Village Health Guides (VHGs) should be given clear-cut messages on these aspects.

4. Education materials like manuals, audio-visual aids have to be developed for use by the peripheral workers.

The delegates visited Primary Health Centres around Hyderabad to observe the working of peripheral workers in the implementation of national nutrition programmes. The Workshop also discussed in depth the aspects of proper implementation, infrastructure and monitoring of ongoing national nutrition programmes at various Primary Health Centres in the country.

NEW PUBLICATIONS

"A MANUAL OF LABORATORY TECHNIQUES" Edited by N. Raghuramulu, K. Madhavan Nair and S: Kalyanasundaram (360 pages). Published by National Institute of Nutrition, Indian Council of Medical Research, Jamai Osmania, Hyderabad-500 007, A.P. (Price. Rs. 30/-).

The manual caters to the needs of upcoming research workers and institutions engaged in biomedical research. It describes a range of laboratory methods and a brief enunciation of basic principles and description of instruments used in research work. The coverage includes information on analytical techniques; methods in analysis of food, plasma, urine; assays of hormones and enzymes; techniques of animal experimentations. Experimental designing, interpretation of data and statistical considerations also find a place.

"LATHYRISM - A PREVENTABLE PARALYSIS" (Revised) 26 pages. Published by National Institute of Nutrition, Indian Council of Medical Research, Jamai Osmania P.O., Hyderabad - 500 007. A.P. (Price. Rs. 1/50.)

The booklet indicates the current developments on the problem of Lathyrism. The major developments are that during the last few years the incidence of this disease has come down. The possible

reasons for this could be (1) decreased intake of Lathyrus as a result of record output of wheat in North and the introduction of "Food for Work" Programme and (2) increased prices of Lathyrus and other dhals. In this context there is an urgent need for social management of this disease. This is highlighted in the booklet.

RESEARCH NOTES

IN VITRO DIGESTION OF DIETARY PROTEINS

The pattern of amino acids and peptides released during in vitro sequential enzymatic digestion of some plant and animal proteins was studied. Included in the analysis were eleven proteins - five animal proteins namely bovine serum albumin, casein, α- lactalbumin, egg albumin and meat lyophilysate and six plant proteins, namely gluten, zein and protein isolates of soya bean, groundnut, rice and red gram. The biuret method was used to estimate the dipeptide content of the different peptide fractions obtained after separation of the enzyme digests of different proteins on copper Sephadex G 25 columns.

Release of total α- amino nitrogen (AAN) was found to be higher with animal proteins than with plant proteins. The extent of peptic digestion was higher in plant proteins compared to animal proteins; the converse being true with regard to pancreatin + trypsin and erepsin digestion. Animal protein digests contained a larger proportion of smaller peptides than the plant protein digests.

Analysis of essential amino acids (EAA) and non-essential amino acids (NEAA) of the different peptide fractions indicated that, in general smaller peptide fractions had a higher EAA/NEAA ratio than larger peptide fractions. Smaller peptides obtained from animal proteins had higher amounts of EAA.

A significant correlation between the dipeptide content of the peptide fraction of the enzymatic digest on the one hand and the quality of the proteins on the other was observed. This indicates that the quantity of dipeptides or the small peptides, in general, released during digestion of dietary proteins may play a role in the determination of the quality of the dietary proteins.

EFFECT OF RICE BASED MEAL ON CHLOROQUINE ABSORPTION

It was reported earlier that wheat based diets increased the absorption of chloroquine, compared to fasting state. A study was undertaken with rice based diets to ascertain whether this effect on chloroquine absorption was specific to wheat diets, or applicable to foods in general. Six apparently normal male volunteers aged between 25 and 35 years with normal serum albumin levels (3.6 ± 0.12 g/dl) participated in the study. Each subject was administered a single oral dose of 600 mg chloroquine base on two occasions; on empty stomach after an overnight fast and along with a rice based meal.

The meal consisting of 125 g rice, 10 g visible fat and 350 g vegetables supplied 565 calories, 9 g proteins, 109 g carbohydrates and 11 g fat. Three of the subjects, on the first occasion received chloroquine on empty stomach whereas the other three received chloroquine along with the rice diet and the order was reversed on the second occasion. A gap of 15 days was given between the two occasions. Timed blood samples were obtained upto 12 hours after the ingestion of the drug. Chloroquine in plasma samples was assayed.

The results indicate that chloroquine bioavailability is significantly enhanced by food supplements. The added advantage of such food supplements is, reduced gastrointestinal irritation. Chloroquine is known to produce such irritation.

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170
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CURRENT TOPIC

GROWTH RETARDATION AND MALNUTRITION

In large areas of the world today, malnutrition, especially among young children (1–5 years) is one of the important public health problems. Mortality and morbidity levels are high in malnourished children and even common infectious diseases can often become catastrophic. Quantification of malnutrition therefore becomes important. This is possible through clinical examination and also through assessment of growth status if there is a good agreement between nutritional status and body (anthropometric) measurements.

Body composition has been known to be affected in severe forms of malnutrition. It is therefore important to work out the best set of anthropometric measurements, each of which provides some information about the development of the major components of the body – namely skeleton, muscle and fat.

NUTRITIONAL STATUS AND RELATED FACTORS

NIN has carried out studies on interrelationship between malnutrition and growth status in toddlers. Surveys have revealed that prevalence of nutritional deficiency disorders such as PEM (protein energy malnutrition), hypovitaminosis A, anaemia and vitamin B-complex deficiency signs is very high among rural Hyderabad preschool children. Prevalence of vitamin A and B-complex deficiency signs increase with age. Signs of PEM are higher in younger age groups of 1–3 years than in 3–5 years, while vitamin deficiency signs are more in 3–5 year age groups. The peak prevalence of kwashiorkor is frequently seen in the age group of 2–3 years and marasmus in 1–2 years. About 50% of children are anaemic (Table: See page 2).

CLINICAL NUTRITIONAL STATUS AND BODY MEASUREMENTS

[illegible] made to find out the relationship between nutritional status and certain body measurements. Measurements used in this connection are body height, weight, circumferences of arm, chest, head, arm muscle and calf, and fat folds at triceps and calf length. These measurements reflect skeletal growth, muscle and fat components of the body. Such measurements in respect of children apparently normal without any clinical deficiency signs are compared with those of PEM children with two or more clinical signs – kwashiorkor (swollen body), marasmus (emaciation), hair changes, moon face etc., and in those with deficiencies of A and B-complex vitamins. All these measurements are significantly lower in PEM children, thereby showing poor growth of skeleton, fat and muscle components. In severe cases of PEM admitted to hospital, measurements reflecting fat and muscle components are affected more significantly than measurements reflecting skeletal growth.

Children with poor grades of growth status as judged from body measurements have higher prevalence of various forms of PEM than those with better grades of growth status. In cases where the child shows good body growth, there was a tendency for higher prevalence of vitamin A and B-complex deficiency signs.

GROWTH RETARDATION AND PEM

Measurements – fat fold at triceps, fat fold at calf, arm circumference, calf circumference, chest circumference and head circumference are reduced to the extent of 43.4%, 37.1%, 17.2%, 13.2%, 3.5% 2.4%, respectively, in case of severe hospital PEM cases as compared to PEM cases observed in rural community.

In all rural Hyderabad children, when compared with measurements of high socio-economic group, it was found that the extent of growth retardation was of the order of weight (30.7%), fat fold at triceps (23.1%), and chest circumference (11.1%). These retardations are due to chronic food inadequacy and poor environment with other contributing factors like infections, large family size, poor maternal care etc. Elite Indian children with facilities of good

PREVALENCE OF NUTRITIONAL DEFICIENCY SIGNS IN RURAL HYDERABAD PRESCHOOL CHILDREN BY AGE

Age in Years	Number of Children investigated	Protein Energy Malnutrition		Marasmus / Emaciation	Kwashiorkor / Edema	Deficiency of		Anaemia**
		2 signs	3 or more signs			Vitamin A*	Vitamin B complex	
1–2	1696	2.0	0.7	6.5	1.0	7.3	3.5	59.4
2–3	1704	3.1	1.4	4.3	1.3	6.6	9.5	63.9
3–4	1766	1.8	0.8	1.7	0.6	11.2	14.2	49.0
4–5	1394	0.5	0.2	1.1	0.1	17.4	19.7	36.3
1–5	6560	1.8	0.8	3.4	0.8	10.6	11.7	52.2

* – Vitamin A deficiency includes keratomalacia, Bitot's spot, night blindness and conjunctival xerosis.

** – Prevalence of anaemia as assessed on a sub-sample of children with criteria of Hb level of 11.0 g/dl as the minimum level.

Note : Differences between age groups and sex were significant ($P < 0.01$).

environment, nutrition and maternal care were found to have heights or weights similar to those of Western countries like U.S.A. who are taken as standards.

GROWTH STATUS AND PREVALENCE OF ANAEMIA

Severe anaemia (with haemoglobin levels lower than 8 gm/dl) is more frequently seen in severely undernourished children than in others. Severe forms of PEM are also more in children with severe or mild anaemia (8–11 gm/dl haemoglobin levels) than in normals. Children with severe forms of iron deficiency are also often observed to exhibit signs associated with deficiencies of calories, proteins, vitamins and minerals. General inadequacy of the dietaries is reflected in poor growth status, higher prevalence of severe anaemia and severe forms of clinical protein energy malnutrition. Nutritional status, dietary inadequacy and infection might together play an important role in the behaviour of haemoglobin levels.

NEED FOR AGE INDEPENDENT ANTHROPOMETRIC MEASUREMENTS

So far, we have been discussing use of body measurements such as height, or weight or arm circumference etc. for assessing the nutritional status of the child. But when considered individually, such parameters are dependent on the age of the child. That is, unless, we know the age of the child precisely, we cannot judge correctly whether the measurement we are considering is satisfactory or not (for that age). The need for age independent anthropometric measurements for the nutritional assessment of young children for use in developing countries of the world, where birth dates cannot be verified by documentation has been appreciated for years.

THE CENTRE-SPREAD (Data given in the centre-spread pertain to the consumption of calories and proteins/cu/day in the districts of Maharashtra).

Calories :	Districts :
Adequate (≥2400 Kcals)	5, 9, 14, 15, 16
Marginally Adequate (2000–2400 Kcals)	1, 3, 6, 7, 8, 10, 11, 12, 13, 17
Not Adequate (< 2000 Kcals)	2, 4
Proteins :	
Adequate (≥55 g.)	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
Marginally Adequate (45–55 g.)	2
Not Adequate (< 45 g.)	–

Data presented here are based on the average figures reported from the districts covered by the National Nutrition Monitoring Bureau (NNMB) in the State.

Cut-off levels are arbitrary

Prominent among those suggested for age independent parameters have been arm circumference/arm length, calf circumference/height, weight for height weight / height^2 etc.

Attention to this aspect has been given in studies carried out at NIN. These studies showed that weight for height and weight / height^2 are more sensitive than other measurements or indices. Values of these indices showed a wide range of reduction in cases like kwashiorkor and marasmic kwashiorkor. Children with standard values of weight for height or weight/height^2 were found to have good gain in height and weight.

ASSESSMENT OF NUTRITIONAL STATUS – APPROPRIATE APPROACH

Severe and acute protein energy malnutrition results in early weight loss, mainly from the depletion of subcutaneous fat and muscle. If PEM is less severe, it results in a failure to gain satisfactory weight. This leads to reduced weight for given height. Height is an indicator of linear growth over a period. Unlike in case of weight, once gained, height cannot decrease; also it is relatively less affected by acute and short episodes of malnutrition, but is affected by chronic or long duration malnutrition.

Body weight does not distinguish between deficit which may arise as a result of reduced height and deficit that may be due to loss of fat or muscle tissue, when height is satisfactory. Combinations of anthropometric measurements and indices such as height and weight for height; height and weight/height^2 have been found useful for classification of various forms of PEM.

If height and weight for height are lower than the suggested minimum value (height<90%), weight for height (<80%) of the standard in a child or community, they can be considered as having long and short duration severe malnutrition. If height is lower than the minimum value and weight for height is in between 80–90% of the standard the children can be taken as having chronic and current moderate form of malnutrition. If both are above 90% of the standard values, the children may be treated as having normal growth. It may be possible to have children with height lower than the normal value (<90%) and weight for height normal (>90%) and they can be treated as having only long duration or chronic form of malnutrition. Those having height normal (>90%) and weight for height below normal (<80%) can be treated as having only current severe form of malnutrition. If children are found with height normal and weight for height in between 80–90% of the standard, they can be considered as having current moderate forms of malnutrition.

Recent studies from India and other developing countries have shown that well-to-do children brought up in good environment have heights and weights similar to American standards (Harvard, or latest available from studies of National Centre for Health Statistics of USA). These standards may therefore be used as international standards to facilitate world wide comparisons and for evaluation of growth retardation.

– Dr. K. Visweswara Rao, NIN.

RESEARCH NOTES

ANAEMIA IN CHILDREN

Critical levels of haemoglobin laid down by World Health Organisation do not indicate true extent of deficiency of iron and vitamins responsible for anaemia. It has been suggested that the measure of response to haematinic supplements may be taken into account to estimate the problem in our community. Anaemia was assessed in school age children using this approach.

Two hundred and ninety three school children were given haematinic supplements on alternate days for a period of one year and haemoglobin was estimated at three monthly intervals. After supplementation of one year the final haemoglobin level of children was found to be 14.2 ± 1.0 (Mean $\pm$ SD). From this, a cut off level of Mean -2SD was calculated and was found to be 12.2 g/dl. Depending on the extent of change in haemoglobin level, the children were classified as being either respondents or non-respondents. 17.5% of children had haemoglobin levels below the cut off level of 12.2 g/dl indicating that they were anaemic. Another 11.5% of children who had haemoglobin levels above 12.2 g/dl responded to the supplementation, indicating that they were potentially anaemic. So, the true extent of anaemia in this community was found to be 29% which included apparently anaemic children and potentially anaemic children. It is therefore felt that this approach would be useful to organise any control or prevention programmes against anaemia and to evaluate such programmes.

PLASMA PROTEIN BINDING OF BASIC DRUGS

Evidence indicates that protein binding of basic drugs is different from that of acidic drugs. Albumin is the major binding protein for acidic drugs and in

undernutrition, there is a significant reduction in bound fraction of albumin bound drugs. Drugs such as propranolol, alprenolol and antidepressants like the tricyclics, bind to α_1 acid glycoproteins. Since only the free drug is considered to be pharmacologically active, large differences in binding can account for significant alterations in clinical response, α_1 -acid glycoprotein is a low molecular weight protein and is one of the acute phase reactants and its concentration in plasma is known to rise in short and long term infections.

A study was undertaken to determine both α_1 acid glycoprotein levels and binding of propranolol, which is one of the most commonly used β blockers.

Three groups of subjects consisting of wellnourished adults from the laboratory staff members, wellnourished and undernourished adults of both sexes from the low socio-economic group were investigated. Anthropometric data and other relevant clinical data were recorded. Those subjects who had overt evidence of infection were grouped separately. From each subject, 10 ml fasting blood sample was drawn and plasma separated. Plasma protein binding was determined in duplicates at 37°C by equilibrium dialysis and α_1 acid glycoptotein in the plasma samples was estimated by radial immunodiffusion technique.

Propranolol binding in wellnourished group was lower than that of any other group. The binding was higher in low socio-economic groups whether wellnourished or undernourished. The subjects with overt signs of infection had higher binding. There was a significant correlation between α_1-acid glycoprotein and binding.

The results indicate that the subjects from low socioeconomic group may be having subclinical infections / infestations which increase the α_1 acid glycoprotein resulting in an increased binding of propranolol.

INSTITUTE NEWS

Dr. B.S. Narasinga Rao, Deputy Director, has been appointed as Director of the Institute.

Dr. Narasinga Rao graduated B.Sc., (Hons) with distinction from Mysore University, and later obtained his Ph.D., in Biochemistry from that University, working in the Nutrition Research Laboratories, Coonoor, (now known as National Institute of Nutrition, Hyderabad.

He has over 30 years of research experience in the field of nutrition. During his career, Dr. Rao was deputed to Harvard University, Cambridge, USA, for Postdoctoral research in Biophysics and Isotopes. He has made valuable contributions in the areas of Iron Deficiency Anaemia and particularly its prevention with iron fortified common salt, PEM in children, nutrient requirements of Indians, Pellagra, Trace elements, Bioavailability of contraceptive drugs in undernourished women, Fluorosis. He has published over 135 research papers in various international and national journals.

He is also a member of various high level scientific bodies such as International Atomic Energy Agency etc. Dr. Narasinga Rao has also guided many students in their research work leading to Ph.D., degree from various Universities.

TRAINING PROGRAMMES

The **Seventeehth M.Sc., (Applied Nutrition) Course** will be held between 1st June 1984 and 28th Feb. 1985. Nine candidates, one from Nepal and eight from different states of India are expected to participate.

The **Seventh Annual Certificate Course in Human Nutrition** for Teachers from Agricultural Universities will be held from 1st June 1984 for a period of 2 months. Ten candidates from faculties of Veterinary Science and Food Technology of different Agricultural Universities in India are expected to participate.

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Nutrition News - a bi-monthly publication, produced by the National Institute of Nutrition, Tarnaka, Hyderabad - 500 007, India.

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INDIAN COUNCIL OF MEDICAL RESEARCH NEW DELHI

NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL. 5 No. 4 JULY 1984

170
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CURRENT TOPIC

CONTROL OF ANAEMIA THROUGH FORTIFICATION OF SALT WITH IRON

Anaemia is one of the major nutritional problems of India. It is particularly common among children and women of child bearing age. The condition can become severe during pregnancy. Anaemia is considered to exist when haemoglobin (g. per 100 ml) in blood goes below a particular level, i.e. 13 g. in case of men, 12 g. in case of women and older children, 11 g. in case of younger children and pregnant women. On this basis, nearly 40% of men, 70% of women are known to suffer from anaemia in rural India. In urban areas, however, prevalence of anaemia appears somewhat lower than in rural areas.

Iron deficiency is the most important nutritional factor leading to anaemia. In addition, deficiency of folic acid can result in anaemia particularly among pregnant women and young children. Iron deficiency appears to be caused mainly by poor absorption of iron from cereal-millet based diets consumed in India. Low intake of dietary iron, due to lowered food intake often seen among the poor further aggravates iron deficiency among our population. Iron deficiency and the consequent reduced haemoglobin concentration in blood, particularly when it becomes severe (viz. Hb level below 10g. / 100 ml) is reported to lead to a number of deleterious effects of great socioeconomic relevance. Some of these effects are: (i) impaired work capacity (ii) poor outcome of pregnancy (iii) poor learning ability and (iv) impaired resistance to infection.

Strategies for prevention and control

Its widespread nature and health implications make anaemia an important health problem requiring urgent solution. Realising this, NIN has been directing its research efforts for designing appropriate strategies to control and prevent anaemia in the population. On the basis of NIN studies, distribution of iron folate tablets (60 mg iron and

was proposed to prevent severe anaemia and its consequences among pregnant women. This programme is currently a part of MCH services in our country.

It is realised that iron deficiency anaemia is widespread among all segments of our population. A strategy for improving iron status of the entire population was therefore envisaged. Increasing the iron intakes through fortification of a suitable dietary article was considered as the most practical strategy for improving the iron status of our population and preventing iron deficiency anaemia among them.

Iron fortification programme however requires a suitable vehicle to carry iron. Such a vehicle must be universally consumed and manufactured at a limited number of centres. Under Indian conditions, salt appeared to be the most appropriate dietary article satisfying these requirements. Next a suitable iron compound with good bioavailability had to be chosen. Since cooking salt marketed in India is rather crude with about 4% moisture, addition of iron compounds like ferrous sulphate, an iron compound of choice, poses problems of stability and colour development. After a series of laboratory studies at the Institute, it was possible to identify a formula to fortify common salt with iron so that a stable preparation with satisfactory absorption of added iron resulted. According to this formula, salt is crushed to a coarse powder and mixed uniformly with iron, i.e., ferrous sulphate (3.5 mg/g), orthophosphoric acid (3.5 mg/g) and sodium acid sulphate (5.0 mg/g). In this formula, ferrous sulphate provides iron at 1 mg/g of salt. Orthophosphoric acid prevents development of colour and sodium acid sulphate helps in improving absorption of iron. In place of $FeSO_4$ and orthophosphoric acid, ferric phosphate can be used but it will be more expensive.

Community studies

After the above formula for the fortification of salt was developed, the fortified salt was tested in volunteers for its absorption using the radioisotopic technique. Iron absorption from the fortified salt, when given with a cereal based meal, was satis-

factory and percent iron absorbed from the fortified salt was comparable with that from the meal itself. The fortified salt was stable without colour development or deterioration in its quality when stored for 8 months or more. It was found to be acceptable by families for cooking in the same way as the ordinary salt.

Two long term community studies were carried out to demonstrate the effectiveness of the iron fortified salt to prevent and control anaemia in the population. In one of the studies, iron fortified salt was supplied to and continuously used for nearly 18 months by children aged between 5–15 years living in a hostel attached to a residential school. Another study was a multicentric one, sponsored by UNICEF through Department of Food and coordinated by National Institute of Nutrition. It involved a large population, both rural and urban at three locations of the country. Iron fortified salt was supplied to rural households at two rural centres (Hyderabad and Calcutta) and urban households in Madras. Results of both the studies indicated that iron fortified salt was acceptable to the communities studied and its consumption was accompanied by a significant increase in the haemoglobin levels and a reduction in incidence of anaemia. Its long term consumption for 12–18 months was not associated with any untoward effects whatsoever.

Based on the results of these community studies, it has been recommended to the Government of India to consider fortification of common salt with iron as a public health measure to control and prevent widespread iron deficiency anaemia known to exist in our population. Government of India (Ministry of Food) have accepted these recommendations and have initiated necessary administrative and technical measures to implement the programme on a national level in a phased manner.

The safety aspect

Some reservations are expressed against continued intake of additional iron through fortified salt by the entire population over a prolonged period as this programme would envisage. It is feared that such a continuous intake of extra iron over and above that derived from diet would result in unnecessary loading of body with iron which may increase the risk of infection. This programme envisages an intake of only 10–15 mg. of additional iron and its absorption is however limited by the diet with which it is consumed. A close examination of various pieces of currently available evidence on the possible hazard of excess intake of iron indicates that control of anaemia with moderate amount of iron as the current salt fortification programme envisages is safe and is not likely to lead to any increased rate of infection in the population. It may on the other hand improve immune status and other functional capacities of the population.

Salt is currently iodized to control goitre in the endemic areas, i.e. sub-Himalayan belt. Anaemia is also present in these areas. In order to control both the nutritional disorders in these areas, the feasibility of fortifying salt with both iodine and

THE CENTRE-SPREAD (Data given in the centre-spread pertain to the consumption of calories and proteins/cu/day in the districts of Orissa)

Calories	**Districts**
Adequate (≥ 2400 Kcals)	3, 5, 6, 7, 8, 10, 11, 12
Marginally Adequate (2000 - 24000 Kcals)	1
Not Adequate (<2000 Kcals)	4

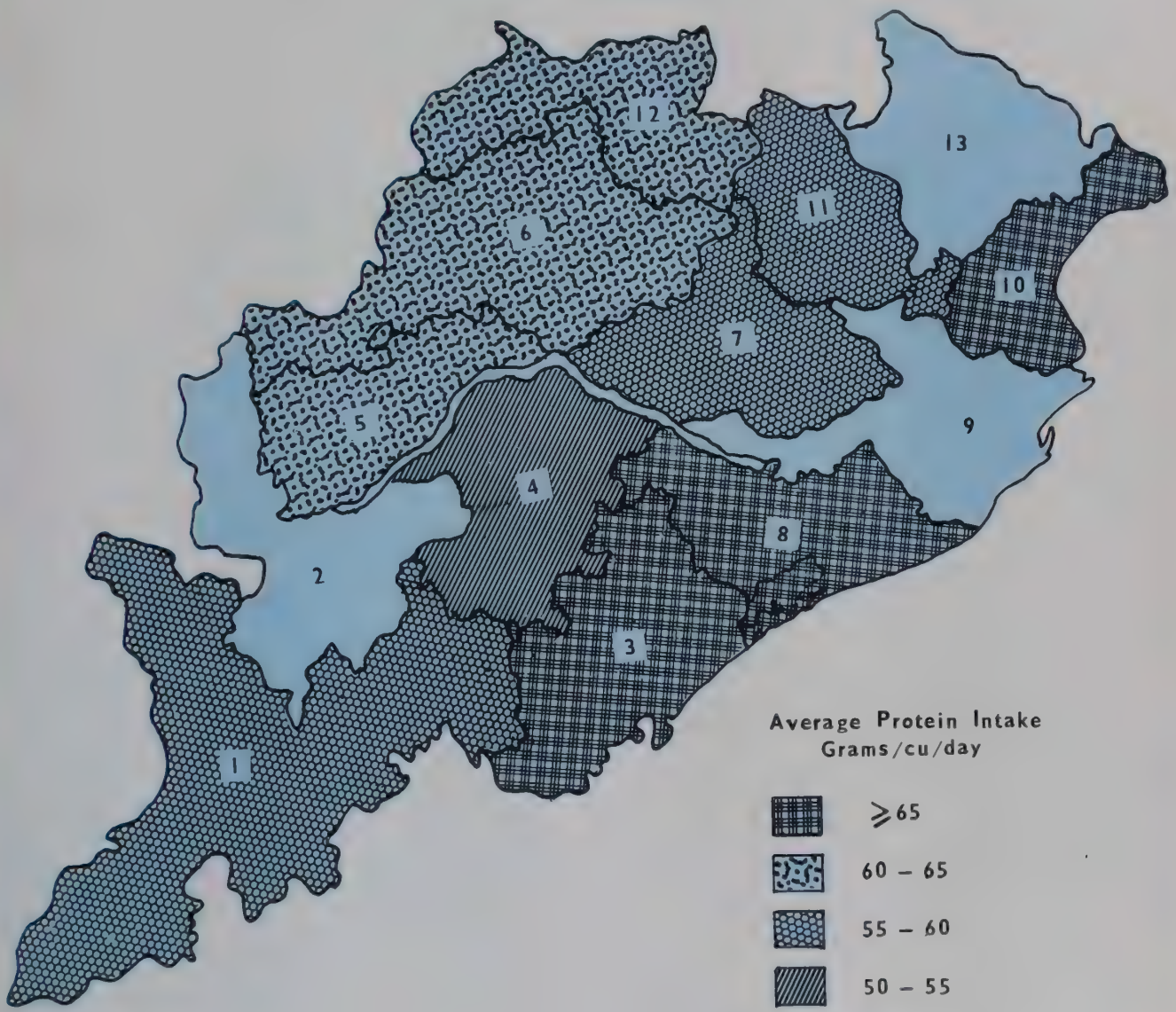
Proteins	**Districts**
Adequate (≥55 g.)	1, 3, 5, 6, 7, 8, 10, 11, and 12
Marginally Adequate (45 – 55 g.)	4
Not Adequate (<45 g.)	–

Data presented here are based on the average figures reported from the districts covered by the National Nutrition Monitoring Bureau (NNMB) in the State.

Cut-off levels are *arbitrary*.

CONSUMPTION OF PROTEINS – RURAL ORISSA

(Source : NNMB Reports, 1975 – 1981, NIN)



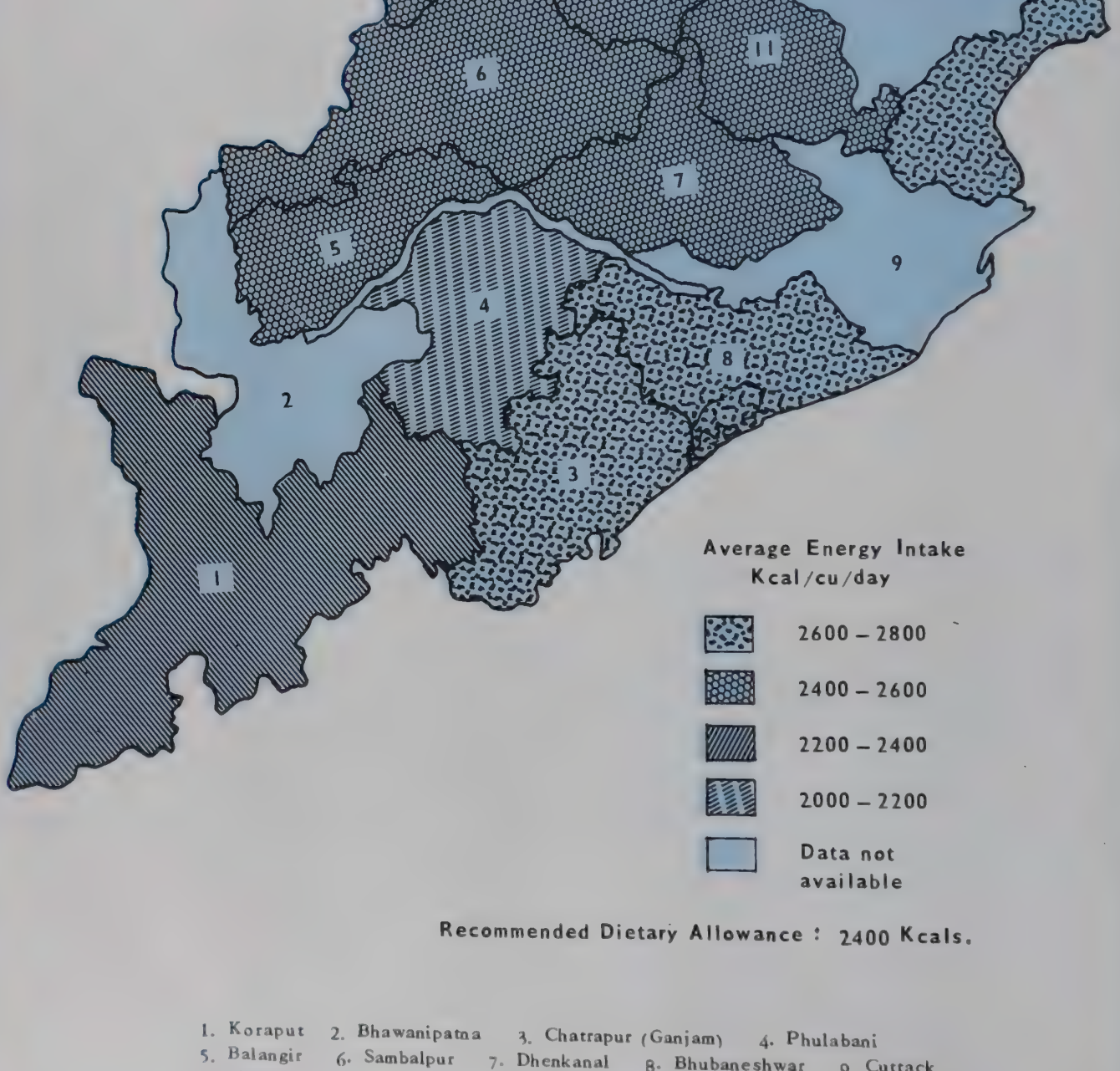
Recommended Dietary Allowance : 55 g.

1. Koraput 2. Bhawanipatna 3. Chatrapur (Ganjam) 4. Phulabani
5. Balangir 6. Sambalpur 7. Dhenkanal 8. Bhubaneshwar 9. Cuttack
10. Baleshwar 11. Keonjhargarh 12. Sundargarh 13. Baripada.

Map of India (Political), Survey of India : 1:4,000,000.

CONSUMPTION OF CALORIES – RURAL ORISSA

(Source; NNMB Reports, 1975–1981, NIN)



Recommended Dietary Allowance : 2400 Kcals.

1. Koraput 2. Bhawanipatna 3. Chatrapur (Ganjam) 4. Phulabani
5. Balangir 6. Sambalpur 7. Dhenkanal 8. Bhubaneshwar 9. Cuttack
10. Baleshwar 11. Keonjhargarh 12. Sundargarh 13. Baripada.

Map of India (Political), Survey of India : 1:4,000,000.

iron was explored at NIN. Addition of iodine (or iodate) to the iron fortified salt (as developed now) indicated a rapid loss of iodine on storage. Hence a new formula for the fortification of salt with iron and iodide has been developed wherein both iron and iodine are stable for over 6 months. Studies on the availability of iodine and iron from the salt containing iron and iodine added according to this formula are currently underway at NIN.

Thus the research efforts of the Institute over the past several years have borne fruit in developing a practical measure to control anaemia in the population through iron fortified salt. This programme needs to be effectively implemented to achieve this goal.

Dr. B.S. Narasinga Rao.

TRAINING COURSES

1. The Institute will conduct the Thirteenth Annual Training Course on Endocrinological Techniques and their Application between 6th August and 21st September 1984. This course will offer training in the practical aspects of hormone assays as well as theoretical areas concerning the principles underlying endocrinological techniques and their application in clinical medicine. Radioactive isotopes and their safe handling, evaluation of thyroid and adrenal function, radioaminoassay of insulin, growth hormone, determination of urinary estrogens are also some of the topics which will be covered.

Eight candidates deputed by Medical colleges and Research Institutes from Gujarat, Himachal Pradesh, Karnataka, New Delhi, Punjab, Orissa, Rajasthan and Uttar Pradesh are expected to participate.

SEMINARS

The following two seminars have been arranged for the participants as part of the Annual Certificate Course in Human Nutrition for Teachers from Agricultural Universities currently in session.

a) 'Animal foods in Human Nutrition': The topics to be covered include:

- Current status of production of animal foods.
- Constraints in the augmentation of animal food resources.
- Impact of dairy development on rural development.
- Utilisation of animal by-products.
- Integration of agriculture and animal food production.

b) 'Food Technology in Human Nutrition': In this seminar, the following aspects in relation to nutrition quality will be dealt with.

- Storage and Post-harvest losses.
- Processing technology of cereals and pulses.
- Food Technology and Development, formulation of weaning / instant foods

PANEL DISCUSSION

A panel discussion on 'Area Development Health Care Projects' arranged for the participants in the current year's M.Sc. (Applied Nutrition) Course is scheduled to be held on 24th August 1984.

The discussion will cover the following aspects:

- An overview
- Components and Health Infrastructure
- Integration of nutrition, health and developmental programmes.

INNOVATIVE EDUCATIONAL AID

Participants of the training courses had the opportunity of being exposed to an innovative aid titled 'Green Revolution Game' developed by G.P.Chapman of Cambridge University and E.A. Dowler of London School of Hygiene and Tropical Medicine. This is a sophisticated simulation game aimed to focus attention on the life of a small farmer belonging to a dynamic society in a developing country.

The game is played by 20 participants, grouped in pairs who take on the roles of farmers living in a traditional village. It seeks to highlight management aspects relating to production of staple food like rice, inequalities in land holdings and family size, food deficits etc. and provides opportunities for participants to experiment with major strategies depending on logistics. The game also pinpoints the difficulties of decision-making regarding new technology for agriculture. This participatory approach to education can be adapted by the participants to their respective work situations.

RESEARCH NOTES

ESSENTIAL FATTY ACID NUTRITIONAL STATUS OF INDIAN MEN

One of the important functions of dietary fat is to provide to the body EFA. Surveys carried out by NNMB over the past few years have shown that among the poor income groups the intake of total energy and fat is low. An attempt was made to assess the EFA nutritional status in subjects belonging to different socioeconomic groups and whose intakes of total energy and visible fat are known to be widely different. The EFA status was measured by determining the plasma total fatty

acid composition. The ratio between the two fatty acids viz. eicosatrienoic (20:3009) and arachidonic (20:4006) acid is an established biochemical parameter for assessment of EFA status.

The mean levels of linoleic acid were low in subjects of low socioeconomic group compared to high socioeconomic group. This can be attributed to the low intake of dietary fat and hence linoleic acid in the former. The mean levels of eicosatrienoic acid and arachidonic acid and their ratio was however, not altered. The levels of other fatty acids were also not altered. The ratio of linoleic/arachidonic acids was similar in all the three groups suggesting that the metabolism of linoleic to arachidonic acid is not affected in undernutrition. The observation that the plasma levels of linoleic acid were reduced but the ratio of eicosatrienoic / arachidonic acids (a good indicator of EFA status) was normal in the very low socioeconomic group (VLSG) suggests that the requirements of EFA may be met even at these levels of linoleic acid intake, derived from the habitual cereal based diets.

The mean levels of plasma total cholesterol were low in both the low socioeconomic groups. Levels of high density lipoprotein (HDL) cholesterol were however similar in all the three groups, suggesting that dietary fat intake and nutritional status may not significantly influence HDL cholesterol levels.

MATERNAL PSYCHO-SOCIOLOGICAL FACTORS AND NUTRITIONAL STATUS OF THE CHILD

In spite of the widely held opinion that malnutrition in early life jeopardizes mental development, the evidence to support this opinion in man is scanty. Furthermore, most of the work has been carried out on children suffering from extreme degrees of malnutrition and there is little evidence of relationship between the much common mild and moderate forms of malnutrition and mental retardation.

Any attempt to measure the influence of nutrition on mental performance must consider necessarily the role played by parental factors such as maternal concern, maternal deprivation and parental level of intelligence.

A study was undertaken to explore how mothers of normal children differ from mothers of malnourished children on selected psycho-social factors. For this purpose, psycho-social factors which were selected included not only the mother's own factors like her intelligence, her set of attitudes and her childhood experiences, but also other factors which are likely to influence her role as a mother. These factors include 'supportive systems' in the family as well as the immediate neighbourhood. 'Supportive systems', a term coined for the purpose of this study, can be understood to mean emotional and social support provided by the husband and other family members as well as neighbours and friends. Other factors which may influence the mother in her psycho-social functioning are the socio-economic status of the family which includes the educational status of parents, their occupation, caste, class and income. Anthropometric measurements were used for classification of children into various nutritional grades.

Data from a sample of 150 women from Edulabad village and their children (219) on mother's intelligence, mother's attitude towards her child, maternal childhood experiences, presence of 'support' or 'supportive systems', maternal anthropometric measurements, socio-economic status and anthropometric measurements of children were collected.

Results reveal that the nutritional status as judged by weight for age of children was related to the nutritional status of mothers. The children whose mothers had higher IQ were nutritionally better. Mothers with higher IQ and higher "supportive systems' were nutritionally better. Mothers and children belonging to better socio-economic status were nutritionally better. Better nourished mothers tend to rear better nourished children.

It may therefore be concluded that since maternal nutritional status is related to child's nutrition and health, factors affecting maternal nutritional status such as socio-economic status and supportive systems are important considerations.

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NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL. 5 No. 5 SEPT 1984

CURRENT TOPIC

WHY NUTRITIONAL RICKETS IN INDIA ?

Historical aspects

Disorders of the bone are, generally speaking, less acute and are not-so-life-threatening, compared to numerous other diseases. It is perhaps for this reason that bone diseases have received relatively little attention by the medical profession. This has been particularly so in the field of pediatrics. Coming under this category is rickets - a long-known bone disorder seen among infants and young children. Softening of the bones and consequent skeletal deformities are the main characteristics of rickets. A similar disorder among adults is known as Osteomalacia in medical parlance.

The word 'rickets' is believed to have been derived from 'rucket' meaning 'difficulty in breathing' - apparently alluding to the improper rib development noticed in the victims. Or the root could be "Wrygates" indicating crooked goings or twisted legs! That exposure to sunlight is essential for a sturdy skeleton seems well appreciated since long. The fact that skulls of Persians were softer than those of the Egyptians was explained by the adequate body exposure to sunlight in the case of the latter. The practice of shaving off the hair and wearing scanty clothing by Egyptians appeared to have provided them with an advantage over the Persians who wore turbans and covered much of their bodies.

Nutritional experiments by McCollum and Mellanby indicated that rickets is a deficiency disease caused by lack of vitamin D.

The finding that both cod liver oil (rich in vitamins A and D) and sunlight prevented rickets was the source of confusion for some time. Insight into this problem was provided by the experiments of Gold Blatt and Soames, Steenbock and others revealing that ultraviolet (sunlight) irradiation results in activation of provitamin D in skin to vitamin D which is anti-rachitic.

In the wake of industrial revolution, Europe and North America witnessed a high incidence of rickets. This was, primarily attributed to large scale smoke emited by factories and consequent air pollution which undoubtedly prevented ultraviolet (uv) light from reaching the skin of children. However, the problem was overcome through fortification of various foodstuffs with vitamin D. Where dietary intakes of vitamin D are inadequate, optimal exposure to sunlight can be expected to prevent rickets.

The situation in India

Vitamin D deficiency rickets and osteomalacia are important clinical problems in India, despite abundant sunshine throughout the year. Rickets is usually described as a disease of rapidly growing children; but many children who come to hospital with overt rickets exhibit retarded growth due to malnutrition. In fact, incidence of rickets has been reported to be higher in malnourished children than in normal children.

It is intriguing that vitamin D deficiency rickets exists in Indian children despite plentiful of sunlight, and growth retardation due to protein energy malnutrition (PEM). These factors are in fact supposed to be highly unfavourable for development of this disease. How can this paradox be explained? No attempts have ever been made earlier to solve this puzzle.

One has to consider here two possibilities. Firstly, there could be impaired synthesis of vitamin D in spite of exposure to sunlight. Or, the metabolism and function of this vitamin may be defective due to PEM. These aspects were investigated recently. The study which included experimental (basic) and clinical (applied) components was to examine the etiopathological factors responsible for rickets in India.

Functional form of vitamin D

There are practically no sources of vitamin D in our common diets, except for egg yolk, butter and some species of fish which contribute only insignificant amounts of this vitamin. However, much of it can be obtained through synthesis from the skin on sufficient exposure to sunlight. Therefore vitamin D cannot be truly called a 'vitamin'. It is well established that vitamin D as such is not biologically active, but has to undergo stepwise modifications to become physiologically active. The synthesised vitamin D is carried to liver through a specific protein and gets transformed to 25-hydroxy cholecalciferol (25 HCC). This major circulating metabolite of vitamin D reflects the vitamin D nutritional status of the organism.

25 HCC is carried by specific carrier protein to kidney where it is again modified to 1, 25 dihydroxy cholecalciferol (1, 25 DHCC) the ultimate active metabolite (Hormone of vitamin D) which exhibits biological activity.

The metabolite 1, 25 DHCC is then transported from the site of production via a plasma specific transport protein to the site of action. At the target tissues the metabolite binds to specific receptor protein and intiates a series of events. These include the synthesis of calcium binding protein, absorption of Ca and P in intestine, mobilisation of Ca from bone and Ca reabsorption in kidney eliciting physiological response.

It is obvious that proteins play an important role in the final expression of biological activities of vitamin D. Therefore it is evident that vitamin D metabolism and function may be influenced by protein nutritional status of the organism. Protein malnutrition also affects organs such as liver and intestines which are important for final expression of the biological activity of vitamin D.

This basic aspect of the study was thoroughly investigated to pinpoint the causative factors responsible for this malady.

Animal experiments

Experiments with rats maintained on low and adequate protein diets clearly indica-

THE CENTRE-SPREAD (Data given in the centrespread pertain to the consumption of calories and protein/cu/day in the districts of Tamil Nadu).

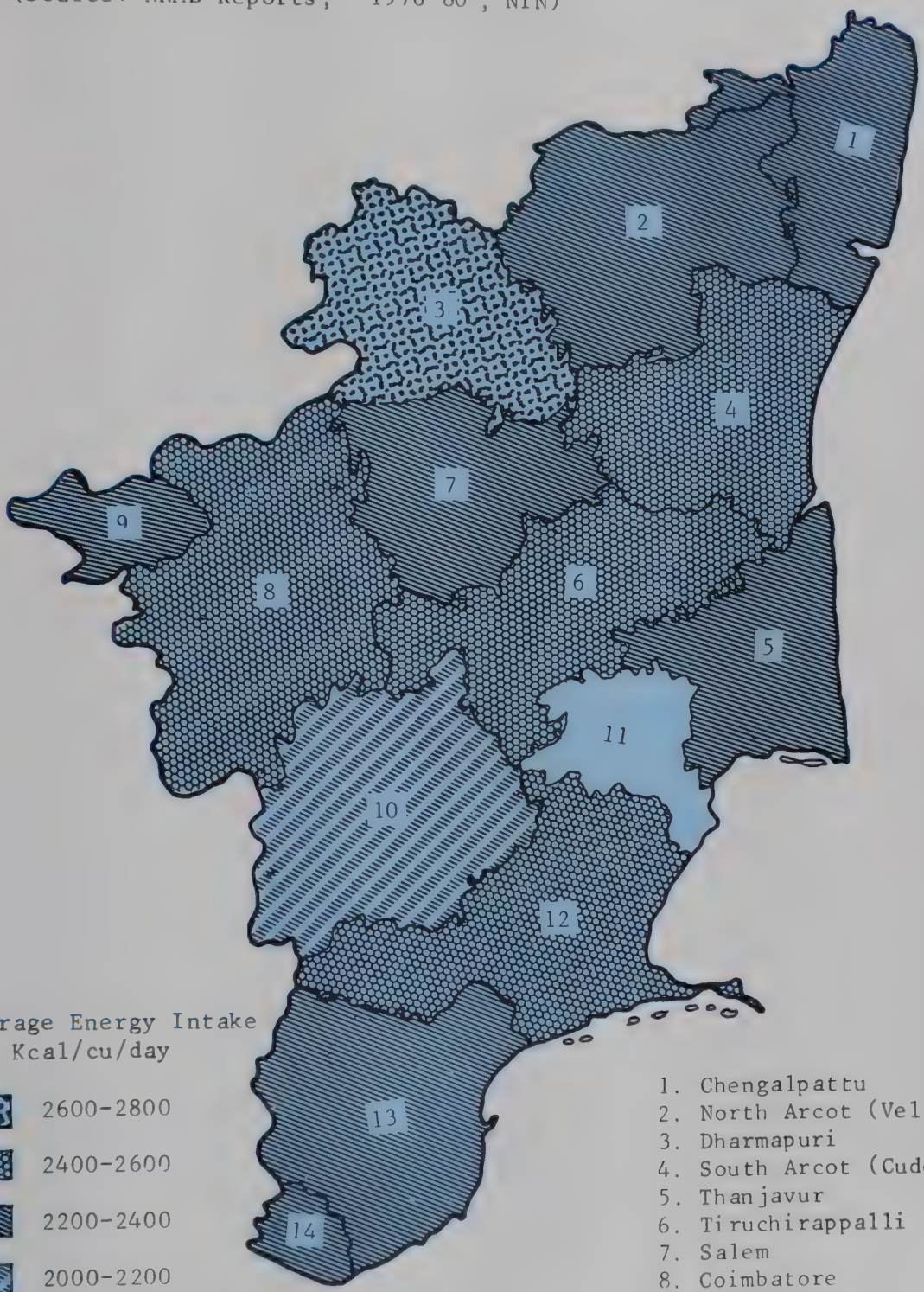
CALORIES:	DISTRICTS:
Adequate ($\geq$ 2400 Kcals)	3,4,6,8,12
Marginally Adequate (2000 - 2400 Kcals)	1,2,5,7,9,10, 13,14
Not Adequate ($<$ 2000 Kcals)	-
PROTEINS:	
Adequate ($\geq$ 55 g.)	1,3,4,5,6,7,8, 9,10,12
Marginally Adequate (45 - 55 g.)	2,13,14
Not Adequate ($<$ 45 g.)	-

Data presented here are based on the average figures reported from the districts covered by the National Nutrition Monitoring Bureau (NNMB) in the State.

Cut-off levels are arbitrary.

Note: Pudukkottai district was formed subsequent to the Survey.

CONSUMPTION OF CALORIES - RURAL TAMIL NADU
(Source: NNMB Reports, 1976-80 , NIN)



Average Energy Intake
Kcal/cu/day

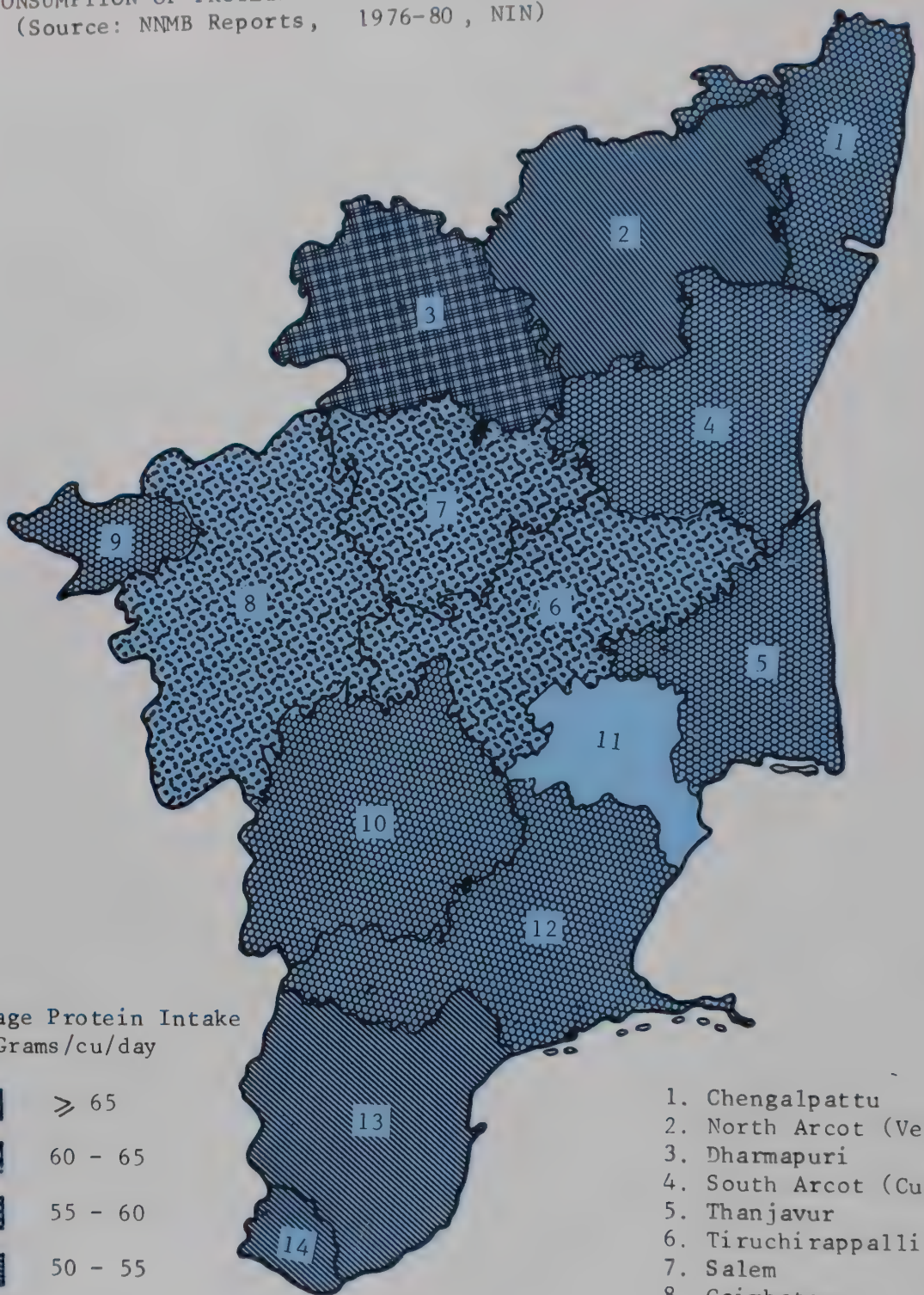
- 2600-2800
- 2400-2600
- 2200-2400
- 2000-2200
- Data not available

Recommended Dietary Allowance: 2400Kcals.

1. Chengalpattu
2. North Arcot (Vellore)
3. Dharmapuri
4. South Arcot (Cuddalore)
5. Thanjavur
6. Tiruchirappalli
7. Salem
8. Coimbatore
9. Nilgiris
10. Madurai
11. Pudukkottai
12. Ramanathapuram
13. Tirunelveli
14. Kanniyakumari

Map of India (Political), Survey of India: 1:4,000,000

CONSUMPTION OF PROTEINS - RURAL TAMIL NADU
(Source: NNMB Reports, 1976-80, NIN)



Average Protein Intake
Grams/cu/day

- ⩾ 65
- 60 - 65
- 55 - 60
- 50 - 55
- Data not available

Recommended Dietary Allowance: 55g.

1. Chengalpattu
2. North Arcot (Vellore)
3. Dharmapuri
4. South Arcot (Cuddalore)
5. Thanjavur
6. Tiruchirappalli
7. Salem
8. Coimbatore
9. Nilgiris
10. Madurai
11. Pudukkottai
12. Ramanathapuram
13. Tirunelveli
14. Kanniyakumari

Based on India (Political), Survey of India, 1:4,000 000

ted no differences in vitamin D metabolism in these two groups of animals.

Vitamin D function in rats on low protein diet was far better with regard to (1) absorption of Ca (2) raising serum Ca and P, (3) bone ash content and (4) healing of rickets as compared to well-fed rats. This needed explanation. Investigations revealed that the specific receptors to 1,25 DHCC were much higher in the intestine of rats receiving low protein as compared to control animals. This clinched the issue as to why animals on low protein diet were super responsive to vitamin D.

Thus protein undernutrition does not interfere with vitamin D metabolism and function. However, these results were obtained in experimental animals. The investigation was extended covering children with rickets and malnutrition to see if this is also true in the human situation.

Human studies

Earlier studies on rickets were largely based on conventional criteria such as alterations in serum calcium, phosphorus, alkaline phosphatase and radiological examination in the diagnosis or prognosis of the disease. However, these parameters have been shown to be of limited value in the case of malnourished children with rickets. Further studies using the assay for 25HCC which is the main circulating form of the vitamin were undertaken. In addition, vitamin D synthesis by the skin on U.V. irradiation was studied in adults.

Vitamin D metabolism in malnutrition

Serum 25HCC levels were measured in normal and malnourished children with or without rickets. Children with rickets had very low serum levels of 25 HCC indicating vitamin D deficiency. A single intramuscular dose of 600,000 I.U. vitamin D to children with rickets resulted in an increase in serum 25 HCC over normal levels. Serum levels of 25 HCC were found to be reduced in malnourished children without rickets as compared to normal children.

The decreased level of 25 HCC observed in undernourished children could be either due to inadequate synthesis of the vitamin or its impaired metabolism. In children with undernutrition and those with rickets, the serum levels of 25 HCC were found to be low. However, the extent of reduction was far greater in children with rickets, suggesting vitamin D deficiency.

Vitamin D metabolism was studied in some normal and malnourished children. No difference was found in the metabolism of vitamin D in both the groups. Serum 25HCC binding protein was found to be normal in malnourished children.

Seasonal (summer, winter) variation of vitamin D nutritional status was assessed in adults, belonging to low and high socioeconomic groups. Serum 25HCC levels were 2½ times higher in summer than in winter and there were no differences between the two groups of subjects studied.

Synthesis of vitamin D by skin

Normal and malnourished adults were exposed to various doses of UV irradiation. Vitamin D synthesis was assessed by measuring serum levels of 25 HCC. There was a significant increase in serum 25 HCC levels afteras short a period as 6.5 min. cumulative exposure to UV light in both the groups. These results suggest that vitamin D synthesis is not impaired.

In summary, it can be said that vitamin D metabolism and serum 25 HCC binding capacity are not altered either in rickets or in protein energy malnutrition. The capacity of the skin for vitamin D synthesis on exposure to UV sunlight is adequate and is not affected by undernutrition. Inadequate exposure to sunlight may therefore be the main etiological factor responsible for the development of the disease.

-Dr.N.Raghuramulu.

RESEARCH NOTES

DIETARY INTAKE OF WORKING AND NON-WORKING LACTATING MOTHERS

Under the influence of urbanisation more and more women today are working outside the home. They constitute about 12% of total female population. The majority of them belong to reproductive age group, and hence they form nutritionally vulnerable groups. The dietary intakes of such women attending MCH centres in Hyderabad city were obtained.

Out of the total 24 urban family and child welfare centres, 15 were randomly selected and from these centres a total of 96 lactating women (of whom 45 were working and 51 were non-working women) were covered for diet survey.

In general the pattern of food consumption between the two groups was more or less similar. So also, average levels of intake of nutrients such as protein, calcium, iron, vitamin A, thiamin and riboflavin were similar among both the working and non-working lactating mothers. However, relatively greater proportion of non-working mothers were found to consume adequate levels of calories as compared to working mothers.

SCOPE FOR NUTRITION EDUCATION AMONG INDUSTRIAL WORKERS

Industrial workers form a strategic group contributing to national economy. They need to maintain good health and nutrition status for optimal work efficiency and output. Three hundred and eighty nine low paid Railway workshop technical personnel were surveyed. All the subjects were homoganous in their character and way of living and engaged in "heavy" to "moderate" level of activity.

Nutritional status of the workers was assessed and their knowledge and practices regarding certain health and nutrition aspects were studied. Similar data on knowledge and practices were also collected from housewives. Information regarding family expenditure on different food items was obtained. Sixty seven families in which housewife was available and cooperated were covered in the household survey.

Heights and weights of workers were below normal values of well-to-do Indian subjects. Scores for knowledge in nutritive value of foods and balanced diets were low for both workers and wives. Same was the case in respect of utilisation of available health care facilities. Nearly 84 per cent of family income was being spent on food. Smoking and alcoholism were common among workers. Educational effort to encourage choice of low cost nutritious foods, better health care utilisation and discourage use of alcohol and unnecessary tonics was suggested.

Managements of industrial houses can reinforce their health education efforts through their canteens, existing health care channels and welfare activities for the families keeping in mind that repeated exposure can result in modification of attitudes in the desired direction.

EXTENSION ACTIVITY

A conducted press tour of the ICMR Institutes was jointly sponsored by the Ministry of Health & Family Welfare, Government of India, and ICMR. This was part of an exercise to bridge the gap between information generators and information users. The party consisting of senior press representatives and media personnel visited the National Institute of Nutrition on 16th July. Prof. V.Ramalingaswami, Director-General, I.C.M.R., Dr. B.S.Narasinga Rao, Director, N.I.N., and senior staff of the Institute had a discussion session with the press party. The visits to various divisions and the field stations gave the party an overview of the different facets of research, extension and training activities undertaken by the Institute.

The visiting journalists evinced keen interest in the applied aspects of nutrition research and the various national nutrition programmes in operation. In particular, the focus was on studies relating to nutritional blindness; anaemia and its prevention through fortification of common salt with iron, formulation of low cost balanced diets, growth norms of Indian children, maternal and infant care. These topics were given extensive coverage in the national press.

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NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD

VOL. 5 No. 6 NOV. 1984

CURRENT TOPIC

NATIONAL RURAL EMPLOYMENT PROGRAMME - AN EVALUATION IN ANDHRA PRADESH

Eradication of poverty and hunger through generation of employment in the community has been one of the main goals of planning in India. In rural areas, labour is mainly agriculture oriented and employment opportunities are limited. Special efforts therefore need to be made to generate work. Food For Work Programme (FFWP) of the Government of India is an effort in that direction. It seeks to provide gainful employment to the rural unemployed during agriculture off-season. FFWP has been in operation in different states of the country since 1977. Under this programme, foodgrains are supplied to the State Governments as grant-in-aid for supplementing their own budgetary provisions for various developmental programmes. In the year 1980-81, the FFWP was redesignated as National Rural Employment Programme (NREP). The major objectives of NREP remained essentially the same as FFWP with the difference that in NREP the assistance from the centre includes not only foodgrains, but also cash. Under the New 20-Point Programme efforts are being made to "strengthen and expand coverage of Integrated Rural Development Programme and NREP".

Under the NREP, the sixth plan envisaged to generate annually 300 to 400 million man-days of work during off seasons. The total man-days generated through this programme was reported to be of the order of 1250 million man-days upto January 1984. The total plan allocation provided for the purpose at country level is Rs. 1,620 crores (Central share is Rs. 980 crores and the rest being the State's share). The Central budget is routed through Ministry of Rural Development, Government of India to Panchayat Raj Departments of State Governments. Implementation of the programme has been entrusted to the District Rural Development Agencies all over the country.

Since food supply forms an essential feature of the programme, it can be expected that the programme may have positive impact on the nutritional status of beneficiaries. A study was undertaken to assess the operational aspects of the NREP, perceptions of the beneficiaries and the impact of the programme on the diet and nutritional situation among the beneficiaries. This investigation was limited to the NREP operating in Andhra Pradesh.

Based on the criteria of maximum utilization of resources provided under the programme, Kurnool district in Andhra Pradesh was selected for the study. Using the same criterion, two Community Development Blocks, namely, Nandikotkur (N) and Pathikonda (P) from the district, were selected. The study was carried out in 19 villages from both the blocks covering about 376 programme beneficiaries. An equal number of non-participant subjects with similar socio-economic, environmental and occupational profiles were also included either from the same or the neighbouring villages, for the purpose of comparison.

Information was collected on nature of works taken up under the programme in the district; wage structure; migration of the labourers; perceived benefits by the beneficiaries and the community's perception about the programme. Food consumption and nutritional status - by anthropometry and clinical examination - were assessed using standard methods.

Body weight profile of preschool

children is considered a sensitive indicator of the nutritional status of the community; the weight profile of preschool children was evaluated using Gomez classification.

Socio-economic profile

Block P was relatively more arid and dry (with no irrigation facilities except dug wells) than that of Block N which had irrigation facilities. As a result, these two blocks differed in certain socio-economic characteristics such as the ratio of the landless to marginal farmers (those possessing less than 5 acres of dry land), availability of gainful employment, wage structure and irrigation pattern. Among the respondents, marginal farmers were 59% in Block P and 18% in Block N.

About ninetythree percent of the subjects interviewed belonged to economically backward classes (B.C., S.C. and S.T.) and ninetysix percent of the programme beneficiaries were labourers engaged either in agriculture or other occupations.

The average period of gainful employment in Block N was 8.15 months per year which was significantly higher ($P < 0.001$) than 6.66 months per year seen in Block P indicating a longer duration of unemployment in the latter Block. No such differences were observed between beneficiaries and non-beneficiaries within each Block.

Summer months (April to June) constituted the lean period, when no agricultural work was available for the labourers. In other words, it would be appropriate to concentrate the NREP activities during this period.

The average usual daily wage rate was Rs.5.59 in Block N which was higher than Rs.3.44 paid in Block P. The average daily wages paid to workers under NREP were Rs.6.27 and Rs.4.85 in those two Blocks respectively. It was interesting to note that the difference in wages between NREP and usual rate was considerable in Block P which is a backward area.

Migration pattern in the two blocks studied indicated that migration was seen only in P Block. In this block about 29% of labour force migrated every year to the neighbouring areas for work. The average duration of migration was found to be about 2.4 months. Analysis of the data suggested that this pattern of migration did not change much in P Block even after implementation of NREP. This only suggests that if the NREP works are patchy and discontinuous they are not likely to make any significant impact on migration. In other words, for the NREP to be effective in reducing migration, the programmes have to be large enough to absorb sizeable number of labour force and be continuous.

Programme awareness and perception

Programme awareness was considerably higher - as can be expected - among beneficiaries.

Fiftyfive percent of the beneficiaries stated that their consumption of cereals

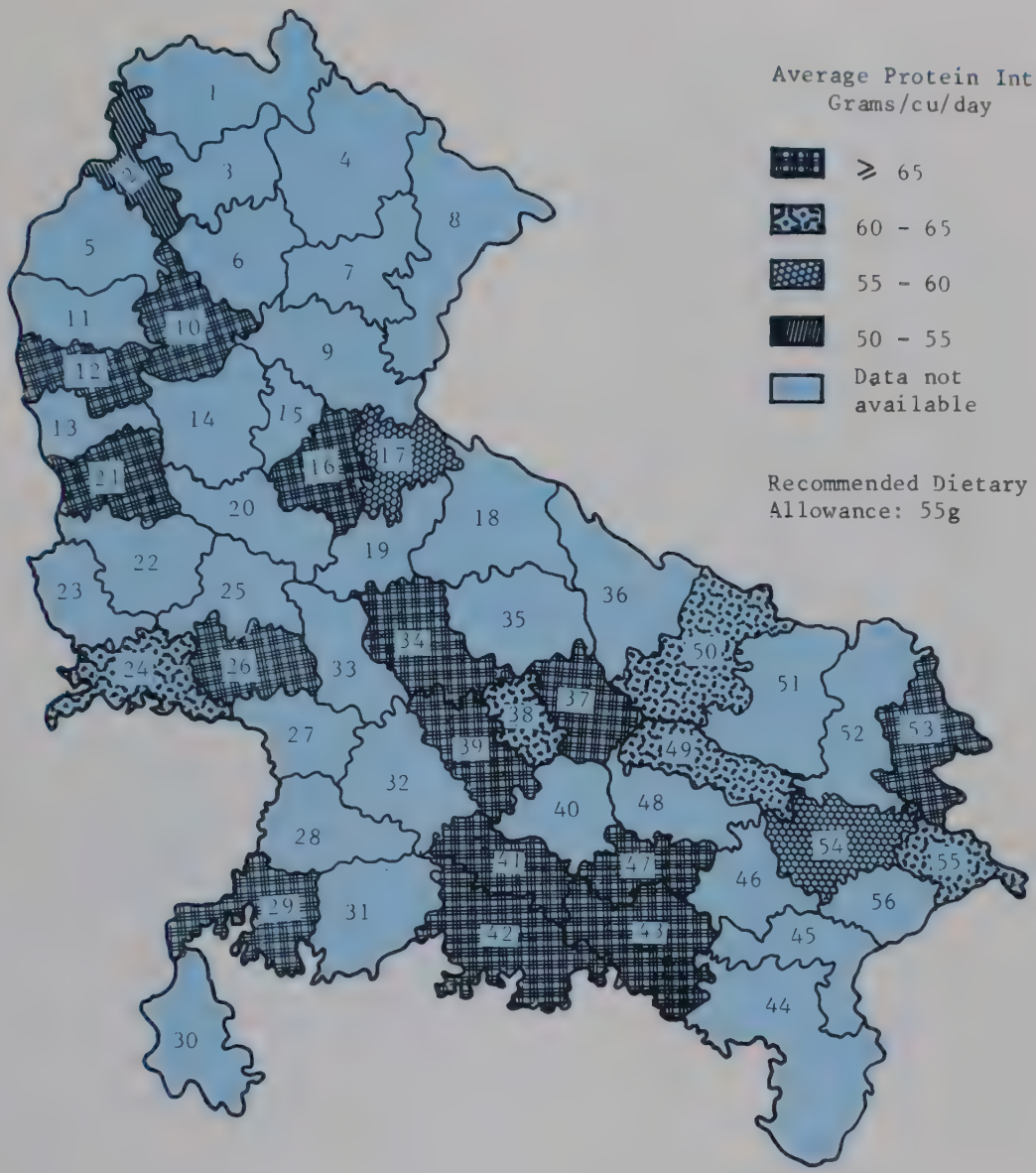
THE CENTRE-SPREAD (Data given in the centrespread pertain to the consumption of calories and protein/cu/day in the districts of Uttar Pradesh).

CALORIES:	DISTRICTS:
Adequate ($\geq$ 2400 Kcals)	16,47,53
Marginally Adequate (2000 - 2400 Kcals)	10,12,17,21, 26,29,34,37, 41,43,49,50
Not Adequate ($<$ 2000 Kcals)	2,24,38,39,42, 54,55
PROTEINS:	
Adequate ($\geq$ 55 g.)	10,12,16,17,21, 24,26,29,34,37, 38,39,41,42,43, 47,49,50,53,54, 55
Marginally Adequate (45 - 55 g.)	2
Not Adequate ($<$ 45 g.)	

Data presented here are based on the average figures reported from the districts covered by the National Nutrition Monitoring Bureau (NNMB) in the State.

Cut-off levels are arbitrary.

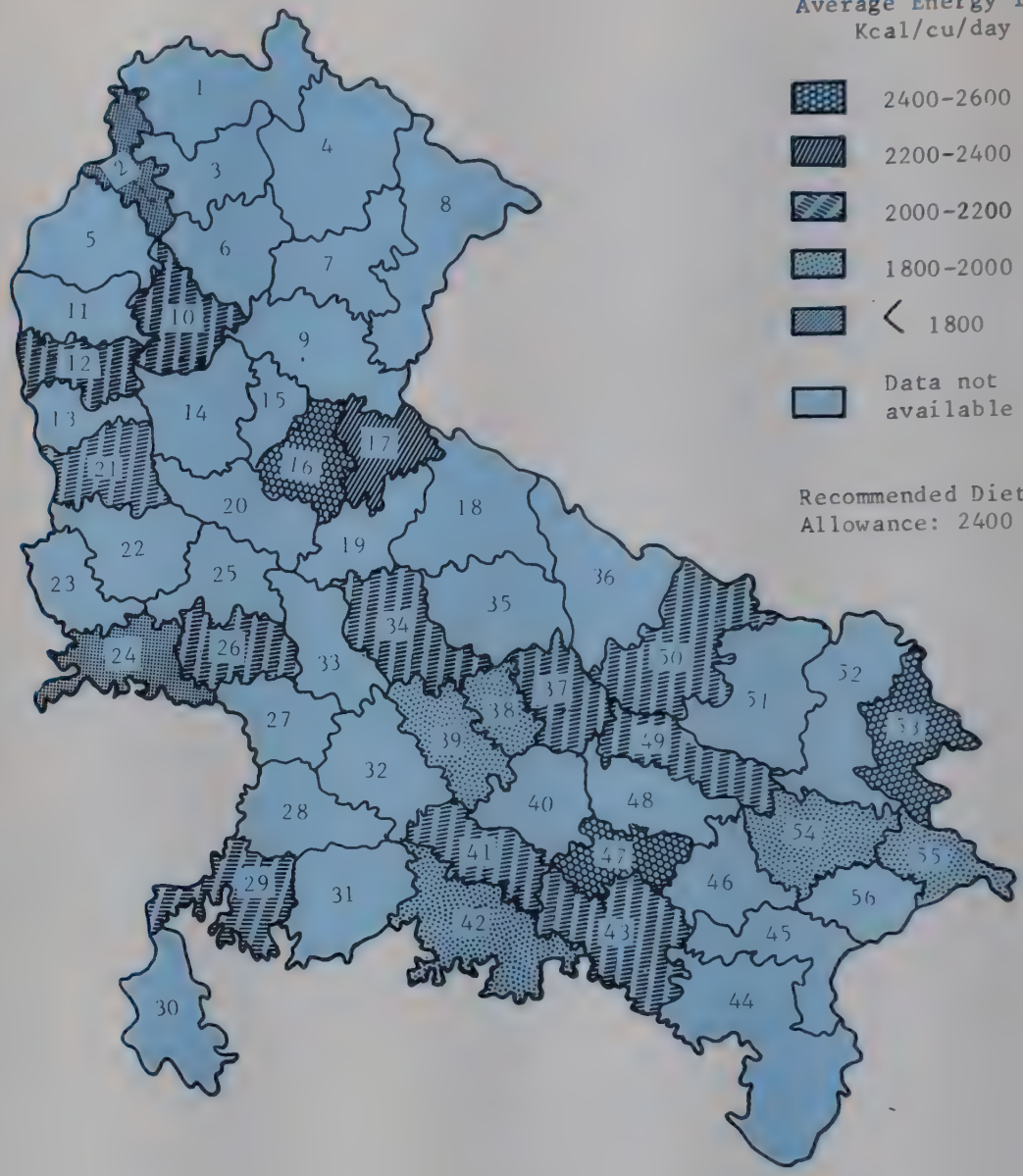
CONSUMPTION OF PROTEINS — RURAL UTTAR PRADESH
(Source: NNMB Reports, 1976—80, NIN)



1. Uttarkashi 2. Dehra Dun 3. Narendranagar 4. Gopeshwar 5. Saharanpur 6. Pauri 7. Almora 8. Pithoragarh 9. Naini Tal 10. Bijnor 11. Muzaffarnagar. 12. Meerut 13. Ghaziabad 14. Moradabad 15. Rampur 16. Bareilly 17. Pilibhit 18. Lakhimpur 19. Shahjahanpur 20. Budaun 21. Bulandshahr 22. Aligarh 23. Mathura 24. Agra 25. Etah 26. Mainpuri 27. Etawah 28. Orai (Jalaun) 29. Jhansi 30. Lalitpur 31. Hamirpur 32. Kanpur 33. Fatehgarh 34. Hardoi 35. Sitapur 36. Bahraich 37. Bara Banki 38. Lucknow 39. Unnao 40. Rae Barelli 41. Fatehpur 42. Banda 43. Allahabad 44. Mirzapur 45. Varanasi 46. Jaunpur 47. Bela (Pratapgarh) 48. Sultanpur 49. Faizabad 50. Gonda 51. Basti 52. Gorakhpur 53. Deoria 54. Azamgarh 55. Ballia 56. Ghazipur.

Map of India (Political), Survey of India : 1:4,000 000

CONSUMPTION OF CALORIES — RURAL UTTAR PRADESH
(Source: NNMB Reports, 1976—80, NIN)



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6. Pauri 7. Almora 8. Pithoragarh 9. Naini Tal 10. Bijnor 11. Muzaffarnagar
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18. Lakhimpur 19. Shahjahanpur 20. Budaun 21. Bulandshahr 22. Aligarh 23. Mathura
24. Agra 25. Etah 26 Mainpuri 27. Etawah 28. Orai (Jalaun) 29. Jhansi
30. Lalitpur 31. Hamirpur 32. Kanpur 33. Fatehgarh 34. Hardoi 35. Sitapur
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was definitely more than usual, while working for NREP. About 29% stated that prior to participating in the programme, they used to miss a meal per day during the lean period. However, after the start of NREP, only 2% reported that they were missing meals.

Comments and suggestions of the respondents

More than ninetyfour percent of the beneficiaries felt that the programme was beneficial. Over three-fourths of the beneficiaries felt that the programme provided them employment opportunities. The beneficiaries also appreciated provision of foodgrains as wages under the programme. Some of them stated that the programme is beneficial since it adds to the community's assets. The episodic nature during the lean periods of the programme was resented by the beneficiaries. They urged that the programme should be continuous in nature, especially in the droughtprone areas. They suggested that provision should exist for supply of millets also instead of supplying only rice as at present. Though, by and large, the quality of the foodgrains was found to be satisfactory, the beneficiaries pointed out that at times, the foodgrains supplied were not of acceptable quality.

Nutritional status

Food consumption pattern was observed to be same in the beneficiaries and controls. Nutritional status of preschool children in beneficiary and non-beneficiary groups was also similar. The major beneficiaries of the programme were the landless and marginal farmers. The wages earned under the programme by the beneficiaries - though for a short duration - were 23% higher than the usual wages of the area. Thus there was no doubt that the programme was beneficial to the needy backward groups and helped increase the wage earnings in the area. However, in view of its short duration, the impact on the wages of the area was not really felt.

Operational Shortcomings

Though in principle, the village panchayats/ committees were responsible for the organisation and management of works in the programme, in practice, masons (who constituted key persons in construction works) seemed to hold important position in decision making. They, in fact, selected the workers and distributed the wages They seemed to be the de facto regulators of works. As a result, they (masons) tended to assume, though unwittingly, the role of the middlemen, elimination of whom was precisely the objective of NREP. It is realised that in any major works, avoidance of such key skilled persons is difficult. But the investigation underscores the need for greater vigil on such unrecognised personal factors which have the potential to limit the benefits of the programme to only a select few.

The benefits of this programme are likely to be perceived more by the people living in an arid and agriculturally underdeveloped areas eg. Block P in the present instance. This is because, in these areas, the problems of unemployment leading to migration of labour force are likely to be more pronounced than in the areas with irrigation facilities. Hence, labour migration factor, drought proneness of the area should form important criteria for its selection for the implementation of this programme.

In general, the majority of the people considered the programme as beneficial, since it provided gainful employment to the local unemployed; prevented migration and tended to ease food situation in a very limited way. The mode of 'cash-and-kind' payment provided for in the programme was liked by most of the workers. However, their only complaint appeared to be the short duration of the works. They opined that the programme should be continuous and spread over the entire year and not restricted to lean seasons only. This highlights the need for explaining to the people the philosophy and the underlying purpose of the programme, i.e., to provide work during the lean employment period so that they avoid conditions of acute food deprivation.

It is realised that positive changes in food consumption pattern and the nutritional status cannot be expected to become evident unless there has been a substantial and sustained gain in household incomes. Impact studies on health and nutritional status of beneficiaries under conditions obtaining in the areas surveyed may have to be deferred until such time the proof of their enhanced purchasing power is established beyond doubt.

—G. Radhaiah,
Dr. K. Vijayaraghavan

RESEARCH NOTES

IMPAIRED COLLAGEN MATURITY IN VITAMIN B_2 AND B_6 DEFICIENCY

Lesions of the mouth such as angular stomatitis and glossitis in humans respond to treatment with either riboflavin or pyridoxine. Experimental deficiency of riboflavin or pyridoxine also produces skin lesions particularly of mucocutaneous junctions in rat and man. Earlier it was postulated that these lesions may be due to the deficiency of pyridoxal phosphate (PLP) since a riboflavin (FMN) dependent enzyme is necessary for the conversion of pyridoxine to its active form PLP. Studies carried out in humans and rats showed that riboflavin deficiency does impair the conversion of pyridoxine to PLP and it also raises the cellular requirement for PLP.

Recent studies have shown that lysyl oxidase which is a key enzyme for initiating collagen maturation by crosslink synthesis is a PLP dependent enzyme. Collagen is the major connective tissue protein. It imparts tensile strength. In view of the requirement of PLP for lysyl oxidase activity and the above mentioned clinical and biochemical interrelationship between riboflavin and pyridoxine, it was hypothesised that the skin changes of riboflavin or pyridoxine deficiency may be due to impaired collagen crosslinking. A defective collagen in the dermis would render the overlying epithelial tissues susceptible to stress and infection, and result in the characteristic skin lesions. To test this hypothesis experiments were carried out in rats.

Collagen maturity can be assessed by measuring its solubility in dilute sodium chloride solution and acid citrate buffer and by determining the aldehyde content and α/β subunit ratio of salt soluble collagen.

The above mentioned parameters were studied in skin collagen from riboflavin or pyridoxine deficient rats and corresponding weight matched and ad lib-fed control animals.

The results show that deficiencies of riboflavin or pyridoxine reduce total collagen, the proportion of insoluble collagen, the aldehyde content of soluble collagen and increase the sub unit ratio. Food restriction has similar effect but of lower magnitude. These data are in harmony with the above mentioned hypothesis. Subsequent studies using ^3H Proline suggests that apart from these changes in properties the synthesis of collagen is also affected in these deficiencies.

The results of these experiments does suggest that the maturation of collagen is affected in riboflavin or pyridoxine deficiency. These molecular events may be aetiologically related to the pathogenesis of the skin lesions in Vitamin B_2 or B_6 deficiency.

TRAINING PROGRAMMES

The Twentysecond Annual Certificate Course in Nutrition for 3-months duration will commence from 1st December 1984. Seventeen participants including one each from Sri Lanka and Bangla Desh and from different States of India are expected to participate.

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NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL. 6 No. 1 JAN. 1985

CURRENT TOPIC

NUTRITIONAL SIGNIFICANCE OF UNCONVENTIONAL EDIBLE OILS:

Nutritional Importance of Edible Oils

Edible oils constitute an integral component of our diets. Dietary fats serve a dual purpose. They are concentrated source of energy (9 K.Cal/g) and help increase energy density of diets. They also help in mobilisation and absorption of fat soluble vitamins present in the diet. Vegetable oils, in addition, are the only (and rich) dietary source of linoleic acid, one of the Essential Fatty Acids (EFA). EFA are not synthesised in the body but are required for vital physiological functions. They are needed for maintenance of cell membrane integrity. Linoleic acid is also used in the body for the synthesis of a group of chemically related compounds known as prostaglandins. These prostaglandins play a key role in controling many metabolic functions in the body.

Recent studies from the Institute have revealed that in an average Indian diet, fats contribute 8-10% of the total energy at a level of 14g-20g per capita of Intake. As against this, fats in the diets of populations from developed regions yield 30-40% of total energy, with the daily per capita levels of fat intake ranging from 70g to 150g. Another major difference is that animal fats are predominant in the diets of people in the developed nations. The ICMR recommendations are daily per capita intakes of 34g of fat for Indians are about 15% of total calories. The current per capita availability of conventional oils and fats has been worked out at only 15.4 g/day, which is about half of the recommended daily allowance. In fact the actual intakes of a large proportion of our population has been observed as being much below this level and often no visible fat is included at all in the diets.

Production trends

DEMAND AND SUPPLY OF EDIBLE OILS IN INDIA.

	1970-71	1976-77	1980-81
	(Million Metric Tonnes)		
Supply	2.50	2.54	3.03
Demand	3.10	3.45	4.48
Deficit	0.6	0.90	1.45

The current estimated deficit level of 3.6 million tonnes is likely to widen further to 7.7 million tonnes by 2000 A.D. i.e. in 17 years. A serious attempt has to be made to fill this gap, at least partly.

In the Sixth Five Year Plan high priority has been given to exploit oilseeds for meeting the consumer requirements of edible oils and reduce pressure on foreign exchange incurred on their imports. Appropriate strategies to meet the national needs are being formulated by ICAR/Agricultural Universities, and various departments of other Universities.

Alongside the dietary requirements, we have to also consider the needs for fats and oils used for non-food pur-

poses i.e. as raw materials for chemical industries such as those concerned with soaps, detergents, surface coating plastilizers, rubber, grease, food additives, cosmetics etc. Oils and fats thus also play an important role in national economy.

Research inputs to improve Edible Oil status

The VI plan production strategies mentioned above have stimulated intensive research by food scientists and biologists. The fascinating biological research with genetic manipulation of fatty acid composition of the oil, is directed at increasing the yields and contributes to the higher production of fats. The vast untapped potential of minor oils which can contribute 1.5 million tonnes, if properly exploited, adds to the increased production. Microbial fats are another source which has a great potential but is yet to be seriously looked into. Yeast and fungi are known to provide biomass containing 30-60% fat. A great deal of research is needed to explore the possibilities of getting good yield of fat for human or industrial needs. Again a great deal of genetic engineering is required to maximise production of fat. More research inputs are needed on sea weeds which are known to accumulate high fat in addition to Iodine. This can prove to be a promising line of approach, particularly in view of our long coastline.

Unconventional sources of Edible Oils

Oils and fats obtained from unconventional sources are already being used for human consumption in limited area where they are grown. These are commonly refered to as minor oils. The available minor oilseed potential of India includes castor, linseed, neem, kokum, mango, dhupa, sal, mahua, phulwarah and karanja. Besides these oils from shrubs like 'Hibiscus Sabdariffa (mesta)', Okra, Watermelon, Chilli and Tomato are also valuable sources. Oils from rice bran and weeds like 'Cleome Viscosa' have recently been found to be valuable for their hypocholesterolemic action.

Food safety systems

The NIN has developed a comprehensive and systematic study of these unconventional minor seed oils including the investigation of chemical analysis, nutritional evaluation and toxicological safety. These multigeneration studies used in the protocol designed by us - taking into consideration the FDA, EEC and WHO food safety protocols. This rigorous analysis ensures the safe edibility of unconventional sources of oils. However such a three generation study is time consuming and expensive and careful thought has to be given for priority selection of oils for the study.

THE CENTRE-SPREAD (Data given in the centrespread pertain to the consumption of calories and protein/cu/day in the districts of West Bengal)

CALORIES:	DISTRICTS:
Adequate ($\geq$2400 Kcals)	2,4,5,7,8,9,12
Marginally Adequate (2000-2400 Kcals)	1,3,6,10,13,14
Not Adequate ($<$2000 Kcals)	15
PROTEINS:	
Adequate ($\geq$ 55 g.)	1,2,3,4,5,6, 7,8,11,12
Marginally Adequate (45 - 55 g.)	10,13,14
Not Adequate ($<$45 g.)	15

Data presented here are based on the average figures from the districts covered by the National Nutrition Monitoring Bureau (NNMB) in the State.

Cut-off levels are arbitrary.

STUDIES ON UNCONVENTIONAL OILS AT THE INSTITUTE:

Mango Kernel Fat:

India produces 7.8 million tonnes of mangoes every year. Mango kernel has a fat content of 6-12% on dry weight basis. India has the annual production potential of 30,000 tonnes of Mango kernel oil. Fat is obtained from the kernel by solvent extraction and acetone fractionation to segregate solid fraction. The product has physical and chemical properties very close to cocoa butter fat which is much valued for its use in bakery and confectionery industries. Melting at 34.5^{0}C, mango kernel fat is cream coloured and solid at room temperature. Cocoa butter fat is not produced in India and is imported at present, involving much foreign exchange. An attempt is made to replace the expensive cocoa butter fat by mango kernel fat to help the national economy. In certain countries, such as Malaysia, a cocoa butter substitute named coberine is prepared from palm oil by suitable technology. India is rich in several indigenous fats which resemble cocoa butter fat. Among them sal (shorea robusta), Mango (mangifera indica) and kokum (garcinia indica) have received greater attention as they are available in plenty. A systematic study for food safety evaluation of Mango Kernel fat was undertaken at NIN. This study indicated that mango kernel fat is toxicologically safe and is not only nutritionally a adequate but can also be a good substitute for Cocoa butter fat in the confectionery industry.

Mesta Oil

Mesta Oil (ambadi or ambari oil) botanically known as 'Hibiscus sabdariffa' or 'Hibiscus cannabinus' is primarily grown in India as a fibre crop. The leaves are edible and the seed contains 20% oil. Annual production of mesta seed oil in India is estimated at 13,000 tonnes. Studies on use of mesta oil for edible purposes revealed that mesta oil in the diet resulted in inferior growth, in poor reproductive performance and altered liver lipid levels which is due to the abnormal oxygenated fatty acids (Epoxy and hydroxy fatty acids) present in this oil. This study indicates that mesta oil may not be suitable for safe human consumption.

Cleome Viscosa Oil

'Cleome Viscosa' (capparidaceae) a weed growing all over the barren lands of India, is also known as wild mustard since its seeds resemble mustard seeds. The whole plant is edible and the seeds have 26% oil. The oil is rich in linoleic acid (70%) and has no abnormal chemical constituents. Nutritional and toxicological studies by multigeneration feeding in rats revealed that this oil can be safely used for edible purposes.

Rice bran Oil

Preliminary studies on rice bran oil indicate that though the linoleic acid content of this oil is equivalent to that of groundnut oil, it shows marked (50%) hypocholesterolemic activity indicating the presence of some potential beneficial factor in it.

Systematic studies on rice bran oil, mahua oil and kapok oil are under way. Research efforts on the lines indicated above have to be intensified to ensure safe edibility of oils from many new sources so that the edible oil scarcity now being experienced can be narrowed down to the minimum.

- Dr. C. Rukmini.

MEETINGS

The Seventh Annual Meetings of Nutrition Society of India were held on 13th and 14th December 1984 at NIN. Around 200 delegates attended the different sessions.

In this connection, two symposia 'Diarrhoeal Diseases and their management' and 'Nutrition in Adolescene' were conducted.

Eighth Gopalan Oration on the theme 'Nutritional Adaptation in man' was delivered by Dr. S.G.Srikantia, former Director of NIN.

WORKSHOP

A 3-day WHO sponsored Regional Workshop on 'Iodine Deficiency Disorders' was held from

18th to 20th December 1984 at NIN. Prof. V.Ramalingaswami, Director-General, I.C.M.R. inaugurated the workshop. The workshop has suggested measures to help in the successful implementation of National Goitre Control Programmes in various regions of the country.

INSTITUTE NEWS

We announce with profound grief the sad demise of Dr.V.Nagarajan, Deputy Director, NIN, on 2nd December 1984. He was the Head of the Food & Drug Toxicology Research Centre and a member of the Editorial Board for Nutrition News. His contributions in the field of food toxicology, especially studies on lathyrism, have won wide recognition. He had also held the post of Assistant Director-General (Nutrition), ICAR, and actively participated in the formulation of EFNAG Programmes in the country.

MCH AID

BALANCE FOR USE BY TRADITIONAL BIRTH ATTENDANTS

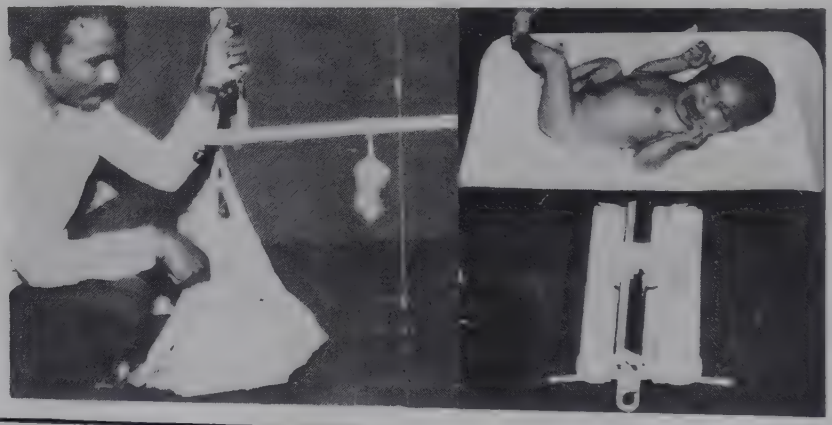
It has been suggested that identification of the high risk low birth weight and premature infants and the early referral to appropriate health facility would bring about immediate perceptible reduction in neonatal mortality rates.

Nearly 90% of deliveries in rural areas around Hyderabad occur at home and are conducted by traditional birth attendants (TBAs). Facilities for weighment of infants are at the moment not available in rural areas . The following are the essential requirements for a balance to be used by a TBA in rural areas :

The balance must be simple, easy to operate, aesthetically acceptable without special skills for manufacture, light and portable. It must be of indigenous make and inexpensive. Accuracy, sensitiveness, reproducibility must be kept in mind.

A Danish steel yard type of wooden beam balance (figure) which meets most of the requirements specified above has been developed by the Regional Occupational Health Centre, Hyderabad, for use for measurement of birth weight in remote tea plantation areas.

This balance has a sensitivity of 50g. and it satisfies all the above mentioned stipulations. Measurements of weight on this balance agreed well with standard beam balances (Seca portable). This balance is currently being tested by NIN in the rural areas of Hyderabad for measurement of birth weight by various health personnel. It is proposed to take up an investigation on its use by traditional birth attendants.



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NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL. 6 No. 2 MAR. 1985

CURRENT TOPIC

DIET AND NUTRITIONAL STATUS OF URBAN POPULATION

During the past few decades, the population in urban areas has been growing rapidly. Quite often, this growth has been unplanned, resulting in increase in slums and make-shift dwellings.

Wide differences exist with regard to income, living and housing conditions and out-reach of health services, not only between the urban and rural populations but even among the different sections of the urban population. Overcrowding and environmental pollution are inevitable consequences of unplanned urbanisation. These factors adversely affect the health and nutritional status of the urban people.

From the standpoint of socio-economic and occupational status, the urban population can be broadly categorised into three distinct groups :

(1) White collared workers who may be further classified into (a) the High Income Group (HIG), (b) the Middle Income Group (MIG) and (c) the Low Income Group (LIG).

(2) Industrial Labourers (IL) and

(3) Slum Dwellers (SD).

The HIG includes top professionals, academicians, senior administrators etc. while para-professionals, office managers, Superintendents etc. form the MIG. The LIG comprises subordinate staff of offices including office helpers, drivers etc.

The National Institute of Nutrition, as a part of its routine activity, has been carrying out diet and nutrition surveys through Ten Regional Units of the National Nutrition Monitoring Bureau (NNMB). Data on dietary consumption, anthropometry and prevalence of various nutritional deficiency disorders are systematically collected on the above mentioned five specific urban groups.

Residents of the cities of Trivandrum and Cochin (Kerala), Madras (Tamil Nadu), Bangalore and Mysore (Karnataka), Hyderabad and Secunderabad (Andhra Pradesh), Nagpur and Pune (Maharashtra), Bhopal (Madhya Pradesh), Ahmedabad (Gujarat), Bhubaneswar and Cuttack (Orissa), Calcutta (West Bengal) and Lucknow and Kanpur (Uttar Pradesh) have been so far surveyed. A total of about 8,200 households were covered under these diet surveys. Nutrition survey was conducted on about 32,500 individuals from these households. An overview of the analysis is given below :

Food and Nutrient Consumption

Consumption (per cu/day) of various foods and nutrients in the different socio-economic groups was calculated and compared with the average consumption (per cu/day) of rural population and Recommended Dietary Allowances (RDA) suggested by the Indian Council of Medical Research (ICMR). A clear-cut socioeconomic differential was observed in the consumption of food and nutrients. The highest levels of consumption (2600calo- and 73 g. protein) were observed in HIG, while the intakes were the lowest (2000calories and 53 g. protein) among the slum dwellers. Further, the HIG households consumed relatively less amounts of cereals and coarse grains like millets and incorporated more of income elastic, protein-rich and protective foods like pulses, milk, vegetables and flesh foods in their diets. Also, a larger proportion of their calorie intake was contributed by fats and oils and sugars as compared to those from the lower income brackets.

Protein Energy Adequacy

Protein energy adequacy or inadequacy status of each household was determined by taking the Mean ± 2 SE of the RDA as cut off level. It was observed that percent of households with energy adequacy level was higher in the HIG while it was lower among the slum dwellers. In the slums, the number of households consuming inadequate amounts of energy was four times greater than those in HIG. In all other economic groups, the population of such households was about three times higher than that in the HIG. The protein inadequacy, though much less (5.9 % in HIG to 25.4 % in slums) compared to energy inadequacy (13.6% in HIG to 54.1% in Slums) showed similar trends in different economic groups.

Nutritional Status

Deficiency signs : The signs of PEM were more frequently seen in children under 5 years of age and the Vitamin deficiency signs in older children, adolescents and adults. Prevalence of deficiency signs tended to be more widespread in the households of slums and Industrial labourers, as compared to white collared, salaried groups. Amongst the salaried groups, LIG had a higher prevalence than MIG. In HIG, the prevalence of PEM and vitamin A deficiency were conspicious by their absence, while the prevalence of B-complex.deficiency was relatively low.

Anthropometry

Comparison of mean values of different body measurements for age viz. height, weight, mid-arm circumference and fat fold at triceps in the five socioeconomic groups indicated that the average values of the measurements, in general, were consistently higher in HIG and lowest among the slum groups. The MIG, LIG and IL groups showed intermediate values. The differences in measurements between LIG and IL were however found to be minimal.The anthropometric measurements of slum groups were observed to be essentially similar to those observed in Rural population.

Growth status of the pre-school children

Growth status of pre-school children (1-5 years) in terms of weight-for-age is considered to reflect the general nutritional status of the community to which they belong.

The growth status of children from HIG was the best followed by MIG, while [illegible] children from slums was poor. Children of the other two groups namely, the LIG and

THE CENTRE-SPREAD

Data presented in this issue pertain to the qualitative aspects of diets of different socio-economic groups. Intakes of income-elastic dietary constituents such as pulses, milk, fats, sugar/jaggery are compared with levels (% of dietary calories) as suggested by ICMR (1981). ICMR (1981) has recommended a daily intake of 40 g. of pulses, 150 ml. of milk and 40 g. of fat in the balanced diet of an average Indian.

Figures are based on surveys carried out on about 8,200 households and 32,500 individuals from the following cities :

Hyderabad : (Andhra Pradesh), Ahmedabad : (Gujarat), Bangalore and Mysore : (Karnataka), Trivandrum and Cochin : (Kerala), Bhopal : (Madhya Pradesh), Nagpur and Pune: (Maharashtra), Bhubaneshwar and Cuttack : (Orissa), Madras : (Tamil Nadu), Lucknow and Kanpur : (Uttar Pradesh), Calcutta : (West Bengal).

NUTRITIONAL QUALITY OF DIETS

Intake of Pulses

Higher than suggested levels : HIG, MIG, LIG and IL

Lower than suggested levels : SD and Rural

Intake of Milk

Higher than suggested levels : HIG and MIG

Lower than suggested levels : LIG, IL, SD and Rural

Intake of Fats

Higher than suggested levels : HIG

Lower than suggested levels : MIG, LIG, IL, SD and Rural

Intake of Sugar/Jaggery

Adequate or slightly higher than suggested levels : HIG, MIG, LIG and IL

Lower than suggested levels : SD and Rural

IL, were having more or less similar profiles and holding intermediate position between that of MIG and slums.

Thus it is observed that the dietary and nutritional status of urban population groups exhibited a clear-cut socioeconomic trend with HIG showing higher levels of nutrient consumption and better nutritional status than the other groups and slums registering the lowest levels. The profile of MIG seemed to be closer to that of HIG than the others. The LIG and Industrial labour groups tended to exhibit similarities in most of the nutritional parameters studied. The consumption pattern of various nutrients and the nutritional status of slum dwellers was comparable with that of the rural populations. These observations point out the need for initiation of a number of health and nutrition intervention programmes for slum dwellers.

- Dr. G.N.V. Brahmam, T. Ramnath, J.G. Sastry, Dr.K.Vijayaraghavan and Dr. N. Pralhad Rao.

Editor's Note

Beginning from this issue, The Nutrition News, in its centrespread, will carry data on various aspects relating to the diet and nutritional status of different urban population groups from 15 cities. Findings relating to dietary quality such as pulse to cereal ratio, contribution of calories from fat, milk and sugar are presented in the current issue. Our subsequent issues will bring out further details on nutrient intakes, growth status of preschoolers etc. with respect to these urban groups.

VISITING SCIENTISTS

Two eminent Scientists Dr.David Ian Thurnham and Dr. Andrew Tomkins participated in the teaching programme of the International Training courses of the Institute as WHO Consultants.

Dr. Andrew Tomkins, Senior Faculty, Department of Human Nutrition, London School of Hygiene and Tropical Medicine, London, delivered three lectures on "Role of infection in precipitation of Protein Energy Malnutrition", "Protein Energy Malnutrition as a risk factor for morbidity and mortality" and "Nutrition and health programmes - do they work ?".

He also chaired a seminar meeting on "Is malnutrition a threat to resource development and national productivity?". The other participants in this were Dr. S.G. Srikantia, former Director of the Institute Prof. J.P. Gupta, Joint Director, National Institute of Health and Family Welfare, and Dr. Yadava Reddy, Department of Economics, Osmania University.

Dr. David Ian Thurnham, Senior Lecturer in Nutrition, Wolfson Research Laboratories, Queen Elizabeth Medical Centre and Clinical Investigation Unit, Dudley Road Hospital, Birmingham, England, delivered three lectures which aroused much interest among the staff and participants of the training courses.

The first lecture dealt with studies on malaria in both man and experimental animals. In his second lecture he discussed some work in China on nutrient deficiencies in cancer and in the third the physiological role of marginal micronutrient deficiencies as illustrated by some recent work on iron and riboflavin.

TRAINING PROGRAMMES

VALEDICTORY FUNCTION

The Valedictory Function of the Annual International Training Courses in Nutrition was held on 27th February 1985.

Mr. V.P. Rama Rao, Principal Secretary, Departments of Education, Science and Technology, Government of Andhra Pradesh, Hyderabad, delivered the valedictory address. He stressed the role of research institutions like NIN in developing trained personnel particularly in fields of health and nutrition. He then awarded the certificates to the successful candidates.

Prof. G. Ram Reddy, Vice-Chancellor, Andhra Pradesh Open University, presided over the function.

Six participants in M.Sc.(Applied Nutrition) Course and nine in the Annual Certificate Course in Nutrition received Certificates.

RESEARCH NOTES

EFFECT OF RIBOFLAVIN DEFICIENCY ON RAT LENS PROTEINS

Studies with various animals have demonstrated that riboflavin deficiency is associated with lens opacity. Changes in lens proteins composition and structure have been observed during aging and cataract formation in experimental animals and humans. A study was undertaken to examine the effects of riboflavin deficiency in rats, on the profile of lens proteins.

Weanling male alibino rats were distributed into three groups viz. ad libitum-fed control, riboflavin deficient and pair-fed control. At the end of seven weeks, eight animals from each group were sacrificed. Lenses were analysed for the profiles of total, soluble and insoluble proteins, crystallins and polypeptides.

Mature cataract was not observed in any of the animals. Total protein content and percentage distribution of soluble and insoluble proteins were also similar in lenses from both experimental and control rats. However, the proportion of high molecular weight protein, an aggregate supposed to be the intermediate in the formation of insoluble proteins was significantly higher in the soluble fraction of the lens homogenate, whereas gammacrystallin was significantly lower in lenses from riboflavin deficient rats as compared to lenses from the vitamin supplemented animals.

In vitamin B_2 deficiency the proportion of high molecular weight polypeptides was also increased in the insoluble fraction of the lens homogenate. Such large protein species are believed to cause the loss of lens transparency when present in very high concentrations.

These results suggest that deficiency of riboflavin influences the formation of lens-protein aggregates. These changes are attributed to alterations in glutathione levels, since riboflavin is required to maintain glutathione levels in reduced form. Reduced glutathione protects the protein sulfhydryl groups of the lens from oxidative damage.

METABOLIC EFFECTS OF FEEDING KOKUM

Dried kokum fruit (Garcinia indica) is used as a substitute for tamarind by certain groups of population in parts of West Coast of India. Consumption of these fruits is presumed to help in preventing obesity in this population.

A study on the metabolic effects of feeding kokum to human subjects was undertaken. As it would take a long time to bring about the body weight changes in humans, it was decided to study only the lipid profile in serum. Four, apparently normal adults aged between 30 to 55 years were given kokum fruit extract (equivalent to hydroxycitric acid level of intake of 0.5 mg per kilo calorie) besides their normal self-selected diet. The parameters investigated included serum cholesterol and triglycerides, fasting blood sugar and blood insulin level.

At a level of intake of 0.5 mg hydroxycitrate per K. Cal. (about 30 ml of the fruit extract) over a period of one month, no differences were observed in the levels of serum cholesterol and triglyceride. After one month of kokum ingestion, fasting blood sugar was higher ($P < 0.05$) than initial. Blood insulin level increased significantly-more than double the initial value ($P < 0.01$).

Although the inhibitory effect of hydroxycitrate on fatty acid synthesis is known, ingestion of kokum extract for a short period had no perceptible effect on serum lipids. There appears to be some effect on carbohydrate metabolism, which requires further study.

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NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL 6. No. 3. MAY 1985

Food Science & Technology
Information Service
8 AUG 198
C.F.I.S. Abstracts

CURRENT TOPIC

NUTRITIONAL STATUS AND REPRODUCTIVE PERFORMANCE OF WORKING WOMEN

Women's participation in economically productive activities outside home is not a new phenomenon. Women have been working along with their menfolk in the fields right from the dawn of agriculture. Mankind had developed adaptive processes to ensure that the occupation in or outside the home had no adverse effect on maternal nutrition status.

More and more urban and rural women in the developing countries are now seeking employment in non-traditional occupations outside home because of socio-economic and other considerations. It is estimated that in India working women constitute about 12% of total population and this trend is on the increase.

The type of work a woman does outside the home, availability of domestic help and the economic factors might determine the impact of such employment on her. In some situations, dual stress and conflicting demands of work in and outside the home have been shown to have adverse effect on maternal and child health and nutritional status. On the other hand, employment outside the home may bestow upon the working woman and her family, such benefits as rise in purchasing power and standard of living with consequent improvement in nutritional status. Also working women may have easier access to MCH care and family welfare facilities, with opportunities to utilise the same more effectively. The net impact of such beneficial and adverse effects of women working outside home might vary in different communities depending upon the prevailing conditions of work and home environment.

The National Institute of Nutrition had undertaken during the last three years pilot studies to explore impact of non-traditional types of work outside home on family formation pattern, health and nutritional status of urban and rural working women residing in and around Hyderabad.

Urban working women

A. Upper middle and high income groups

Working women employed as scientific staff in a research institute or physicians working in two local hospitals formed the study group. Housewives, whose husbands were employed in jobs similar to those of the husbands of the working women formed the control group. There were 182 matched pairs in the middle income group (per capita income Rs. 250/- to Rs. 1000/- per month) and 97 matched pairs in the high income group (per capita income more than Rs. 1000/- per month). Women in the study and control groups were both moderately active and had assistance available for household work.

Among working women, some had started going to work after their children had grown up while others had worked throughout. The per capita income, standard of living, expenditure on children's education and investment in long term financial security measures were highest among the latter group, lower among the former group and lowest among housewives' families.

The mean age at marriage of the group of women who worked all through was higher and such women had fewer children. There were no significant differences between working women and housewives in respect of the health and nutritional status of either the mothers or their children.

These data suggest that in these segments of population, working outside the home does not have any adverse effect on health and nutritional status of either the mother or her children. The income generated by

women s employment brought long term benefits like financial security after retirement and better education for children.

B. Lower middle income group

Women working as paramedical and sanitary staff in two local maternity hospitals formed the study population from urban low middle income group. They continued to do the household work. The control group consisted of housewives whose husbands were employed in jobs similar to those of the working women's husbands. For this study 196 matched pairs of women coming from families with per capita monthly incomes between Rs. 150-250 were enrolled.

As expected, the per capita income was higher in working women's families. Children were sent to better schools and school drop-out rates were lower in the families of working women. These families spent more money on long term security such as housing, provident fund and consumer goods which improved the standard of living.

Contrary to expectations, joint families were not more common among the group of working women. All working women reported that child care, especially in the first five years of life, was difficult. Creches at hospitals or near their homes were used or baby sitters employed. Provision of day care centres for children was a 'felt' need among these working women.

Compared to the housewives, working women got married at a significantly later age and had fewer children for any given age. Working women used contraceptives, resorted to medical termination of pregnancy (MTP) more often than the housewives. But being employed in maternity hospitals, the study group had inevitably greater awareness and access to contraceptive and MTP services.

Initiation of lactation was universal among both working women and housewives. Working women tended to introduce dietary supplements to infants earlier. Duration of lactation was unaffected by work outside home, again partly because of their association with hospitals and facilities like creches and time allowed for breast-feeding. All these favourable circumstances resulted in continued lactation in spite of mother's employment outside home. Studies need to be undertaken to investigate the proportion of the working women who enjoy such facilities and the impact of work outside home on lactation and [illegible] survival in the absence of these privileges.

Working women were heavier and had higher values for skin fold thickness, and mid-arm circumference than housewives. It is possible that greater purchasing power had resulted in an improvement in food intake. Obviously in this segment of popu-

THE CENTRE-SPREAD

Data presented in the Centrespread pertain to the growth status (Gomez classification, weight-for-age) of 1-5 year old children and the dietary calorie-protein adequacy of the different socioeconomic groups in the city of Hyderabad(A.P.). Urban data are compared with those obtained on rural subjects of Andhra Pradesh.

GROWTH STATUS OF PRESCHOOL CHILDREN

URBAN : Severe growth retardation was not found among MIG children, while it was maximum (4.4%) among slum dwellers. Percentage of children with normal growth gradually decreased with decreasing income status. Mild form of malnutrition was seen among half the preschoolers in MIG, LIG and IL. Percentage of children with moderate levels of malnutrition increased with decreasing income status. Among the rural population, percentage of normal children was lowest (13.3) while that of severely malnourished children was highest (8).

CALORIE PROTEIN INTAKES

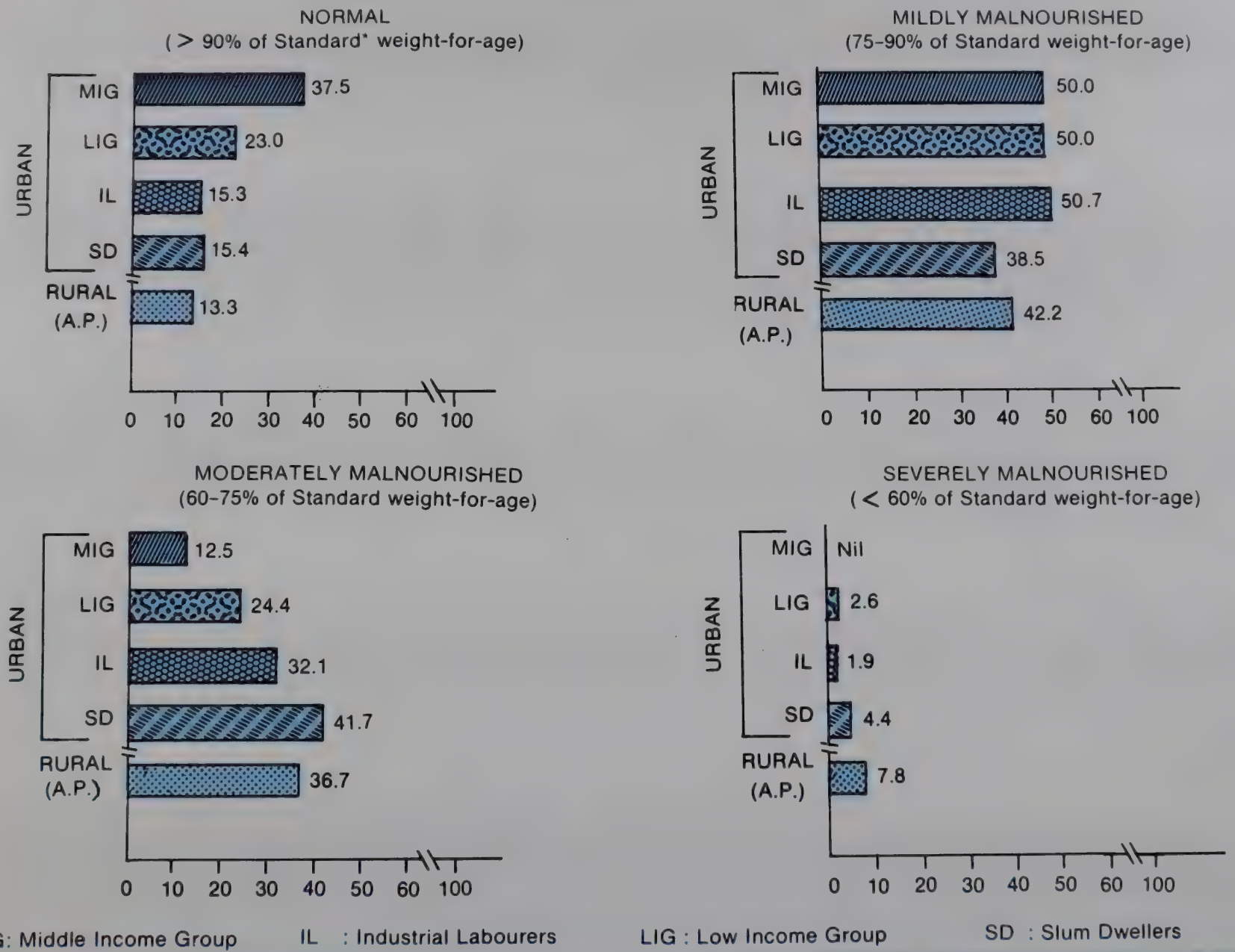
Percentage of Individuals with dietary calorie-protein adequacy ranged from 63 among MIG to 33 among SD. Diets of rural population seemed to be better(56%)in this respect as compared to the urban groups, except for MIG.

Data clearly indicate that the main bottleneck in these dietaries is primary calorie deficiency and not protein deficiency. Calorie inadequacy ranged from about 37% in MIG to 67% in SD, while associated protein deficiency ranged from 7% in MIG to 19% in S.D. Only a very negligible fraction (0.1-0.2%) among the urban groups experienced primary protein deficiency.

Cut-off levels for calorie and protein inadequacy: Less than Mean - 2 standard deviations of Requirements.

PERCENTAGE DISTRIBUTION OF CHILDREN (1-5 yrs.) IN HYDERABAD CITY (A.P.) ACCORDING TO GRADES OF MALNUTRITION

(Source: NNMB Reports, 1975-80)



Sample of Children in High Income Group (HIG) was too small for Analysis

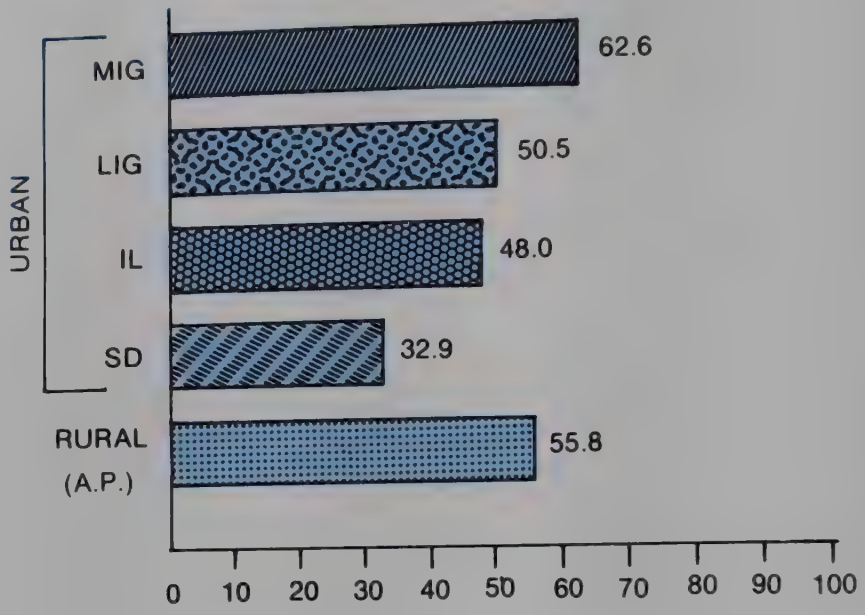
*Standard : Well-to-do Indian children.

MIG: Middle Income Group IL : Industrial Labourers LIG : Low Income Group SD : Slum Dwellers

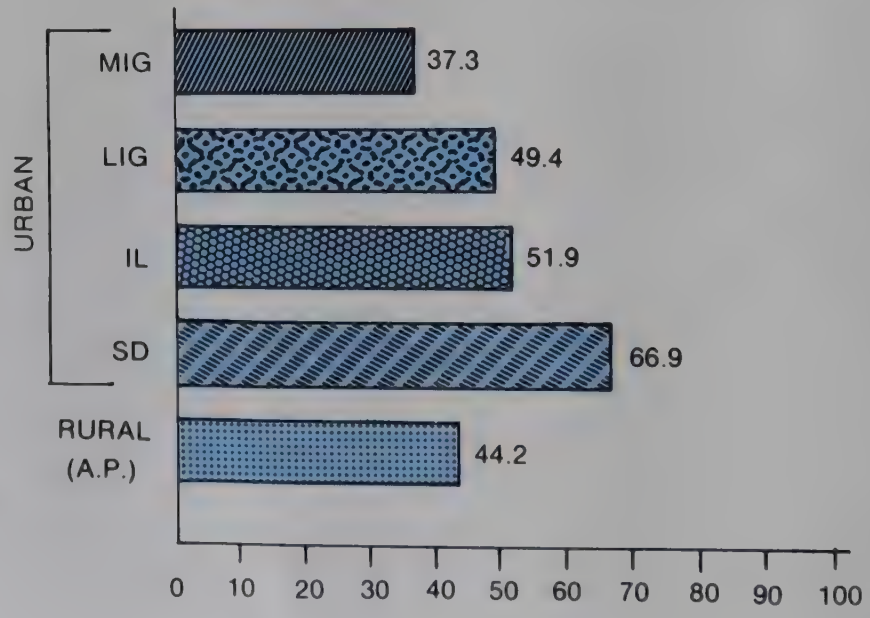
National Institute of Nutrition, Hyderabad-500 007, India.

CALORIE-PROTEIN INTAKE OF DIFFERENT SOCIO-ECONOMIC GROUPS IN THE CITY OF HYDERABAD (A.P.)
(Source: NNMB Reports, 1975-80)

PROTEIN CALORIE ADEQUACY-% OF INDIVIDUALS



CALORIE INADEQUACY-% OF INDIVIDUALS



MIG : Middle Income Group
LIG : Low Income Group
IL : Industrial Labourers
SD : Slum Dwellers

Sample of Children in High Income Group (HIG) was too small for Analysis

lation gainful employment of women results in financial benefits and improvement in maternal nutrition status.

C. Low income group

In the low income group category (per capita income ∠Rs.150 p.m.) 7965 housewives and 1306 working women attending the outpatient departments of two local hospitals were studied.

Husbands of the working women as well as of the housewives were employed as semi-skilled or unskilled labourers but the former were earning less. Because of economic necessity women took up employment mostly as domestic servants, office cleaners or attendants. The combined incomes of husband and wife in the study group families were essentially similar to the earnings of the husband alone in families with no working women (housewives).

In both the groups, over 90% of the family's income was used up for providing the essentials - food, clothing and shelter. There were no differences in the living standards between the families of working women and housewives.

Patterns relating to age at marriage, reproductive performance and contraceptive use were similar among the housewives and working women. Perhaps because the working women were actually employed only as and when there was a demand for unskilled workers, they did not feel that repeated child births came in the way of their employment. These women, especially the domestic servants, took their children with them to work place. So prolonged successful lactation was the rule even among these working women.

The group of working women investigated in this last study were employed in jobs that demanded only moderate physical activity. Data from the study suggest that this type of work outside home did not have any adverse effect on maternal nutritional status or lactation. Information on health and nutritional consequences of heavy manual labour among women has to be obtained for designing appropriate intervention programmes to minimise the possible adverse consequences.

Working women in rural areas

In most of the rural areas around Hyderabad, women from middle income group do not work outside home. But almost all women from low income families are employed in sowing, weeding, transplanting and harvesting work. Only few women from families of landless labourers find gainful employment in other seasons also. Almost all housewives do look after cattle and poultry. Thus in village communities it is very difficult to find housewives who come from similar socio-economic background as the working women for studying the impact of work outside home on health and nutrition status.

Studies comparing housewives (1200) and working women (2091) in rural areas indicate that working women in rural areas came from less educated and economically poorer segments of the village community. Majority of them were working as unskilled labourers on the farms. In spite of their employment, the per capita income of these families remained lower than that of families where women were not working outside home.

There were no significant differences in family formation pattern, obstetric, lactational performance or contraceptive use between women working outside home and those who were housewives.

Women working outside home were lighter and had lower skin fold thickness than housewives. This might be due to general poverty conditions, lower purchasing power and lower dietary intake in the face of strenuous manual labour.

Summary and conclusions

Data from these studies indicate that gainful employment of urban women outside home is associated with (i) improved financial status in urban high and middle income groups, (ii) improved maternal nutritional status in lower middle income group and (iii) prevention of deterioration of nutritional status due to poverty in urban low income group.

Rural working women are undernourished and overworked. It is not possible for them to refrain from working outside home because, if they do so, their families would have still lower economic status and purchasing power. Intervention programmes aimed at augmentation of their income and ensuring sustained employment throughout

the year, might result in mitigation of the observed adverse effect of work outside home on nutritional status of women. Attempts should also be made to explore provision of drinking water facility near home, biogas plants and other energy-saving, drudgery reducing measures that would help these overworked women.

- Dr. Prema Ramachandran

RESEARCH NOTES

HEPATIC TOXICITY OF ISONICOTINIC ACID HYDRAZIDE (INH) AND RIFAMPICIN THERAPY

All antituberculosis drugs with the exception of streptomycin can cause hepatitis but the risk is higher with some drugs. For many years isoniazid has been regarded as one of the least toxic drugs. In recent years however, concern has been expressed about its hepatic toxicity.

Rifampicin, a potent inducer of drug metabolizing enzymes, is now being used in many patients as a second line of therapy and is likely to be the drug of choice in many first line short term chemotherapy regimes. Many rifampicin containing short course regimes (6-9 months) with different combinations, dosage schedules, duration of therapy and different intervals between doses have been evaluated in clinical trials.

Since there are no data on hepatic function in hospital patients on combination therapy of rifampicin and INH, a cross sectional study was undertaken.

The effects of rifampicin (450 mg/day) and isoniazid (300 mg/day) on liver function were studied in 104 adult patients with tuberculosis at various time intervals. Most of the patients were on second line of therapy and were receiving ethambutol/ethionamide along with INH and rifampicin. The patients who participated in the study were undernourished and belonged to the low income group of population.

The results of the study indicated that the subclinical hepatitis in subjects treated with a combination of rifampicin and INH is quite high with more than 40% among males and 50% among females having elevated levels of enzymes. The number of patients with overt jaundice was also higher in the series studied and is comparable to the incidence on prolonged therapy. The observed damage due to combination therapy may be due to the induction of enzymes and formation of hepatotoxic metabolities. However there is tendency for the hepatitis to reverse and appears to be a self-limiting process.

In view of the enhanced risk of hepatotoxicity, in subjects on combination therapy, it is essential to monitor serum enzymes during the chemotherapy with potent hepatic damaging drugs like INH and rifampicin.

TRAINING PROGRAMMES

The Eighteenth M.Sc. (Applied Nutrition) Course and the Eighth Annual Certificate Course in Human Nutrition for Teachers from Agricultural Universities are scheduled to commence from 1st June 1985.

Eight senior medical officers/teachers in medical colleges from the States of Haryana, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan and Tamil Nadu and one from Sri Lanka are expected to attend the M.Sc. (A.N.) Course.

Ten faculty members belonging to the discipline of Home Science from different agricultural universities in the country will participate in the Certificate Course in Human Nutrition.

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C.F.T.R.I. MYSORE

CURRENT TOPIC

MALNUTRITION-INFECTION-THE VICIOUS CYCLE

The mutually adverse interactions between malnutrition and infection are of practical relevance in developing countries where both these conditions are widespread and are often co-existent.

The outcome of an infectious disease in a host is mainly dependent upon the dose and virulence of the infective agent besides the genetic make-up of the host. A number of environmental factors play an important role in altering the course and outcome of the infectious disease. Malnutrition is one of the environmental factors that can tilt the balance of these interactions to the detriment of the host. Infection in turn precipitates malnutrition.

Precipitation of Malnutrition

Various infections common during childhood precede and precipitate malnutrition. Diarrhoea, Whooping cough, Tuberculosis and Measles are the important infections that can precipitate malnutrition in a child.

Diarrhoea : The epidemiological relationship between diarrhoea and malnutrition has been clearly demonstrated by their sequential incidence. The annual peak diarrhoeal season has been shown to precede the period of peak incidence of kwashiorkor by 2-3 months. Retrospective data collected from hospital records document the contributory role of diarrhoea in as many as 70% of children with severe protein energy malnutrition (PEM). These problems of diarrhoea and malnutrition are associated with early weaning when diluted and contaminated feeds are introduced in the child's diet. Recurrent episodes of diarrhoea results in a deterioration of the nutritional status. This predisposes the child to develop further attacks of diarrhoea and systemic infections, by lowering the immune status. Thus a vicious cycle sets in.

Measles : Measles is an acute exanthematous viral infection of childhood, commonly occuring before the age of 5 years. It has been observed that 25% of children seeking admission to hospital for severe PEM have had measles in the preceding 1-6 months period. Measles leads to a significant loss of weight ranging from 1-5% of the initial body weight. Serum albumin levels fall during the acute episode. Added to these initial events, increased morbidity following measles due to various infections causes serious disturbances in the growth of the child during post measles period. Though these consequences of measles are similar in a well-nourished child as well as a malnourished child, these changes are likely to precipitate severe malnutrition in an already malnourished child. The unhygienic environment of the nutritionally deprived poor child favours the establishment of the vicious link between malnutrition and infection.

Tuberculosis : The high incidence of tuberculosis in the underprivileged regions of the world is well known. It is observed to be higher among subjects belonging to poorer segments of the population whose habitual diets are far from satisfactory both in quantity and quality. Incidence of tuberculosis in severely malnourished children is reported to range from 30-50%. The age distribution of the incidence of tuberculosis appears to be similar to that of kwashiorkor. These epidemiological observations suggest a strong association between malnutrition and tuberculosis.

Parasitic diseases : In addition to the bacterial and viral infections, parasitic diseases also are important contributors to malnutrition in the developing countries. Recurrent epidodes of malaria are

known to cause anaemia. The high incidence of iron deficiency anaemia among populations with hookworm infestation is a common observation. The epidemiological findings linking ascariasis and malnutrition are controversial. However, the general opinion is that ascariasis contributes to malnutrition through malabsorption of nutrients, though it is not a major factor.

Apart from precipitating severe PEM, infections are known to cause individual nutrient deficiencies also such as disturbances in vitamin A status following episodes of infections. Diarrhoea and measles are often the noted infections preceding keratomalacia and blindness in malnourished children.

Decreased serum iron and folate levels and increased excretion of ascorbic acid following an episode of infection are also well documented.

Contributory factors : The following factors contribute to the precipitation of malnutrition :

1. Anorexia leads to decreased food intake.
2. Vomiting, which is often associated with infections among children, contributes to significant loss of nutrients. Diarrhoea and several systemic infections also often lead to malabsorption of various nutrients through gastrointestinal tract.
3. Increased catabolism results in excessive loss of urinary nitrogen.
4. The socio-cultural practices and lack of knowledge regarding feeding of a sick child further contribute to nutrient deficiency during infection.

Host susceptibility to infections

Just as infections have been found to have adverse effects on the nutritional status, malnutrition is shown to increase the susceptibility of the host to various infections by altering the host resistance mechanisms.

Malnutrition-Immune response

Disturbances in various host resistance mechanisms have been documented during severe malnutrition.

The leukocytes (neutrophils) constitute the first order of defence against bacteria which cause acute infections. They engulf the pathogens by the process of 'phagocy-

THE CENTRESPREAD

Data presented in the Centrespread pertain to the growth status (Gomez Classification, Weight-for-age) of 1-5 year old children and the dietary status (in terms of calorie-protein adequacy) of individuals belonging to the different socio-economic groups of urban population in Ahmedabad City (Gujarat). The urban data are compared with those obtained on rural counterparts of Gujarat.

Growth status of urban preschool children

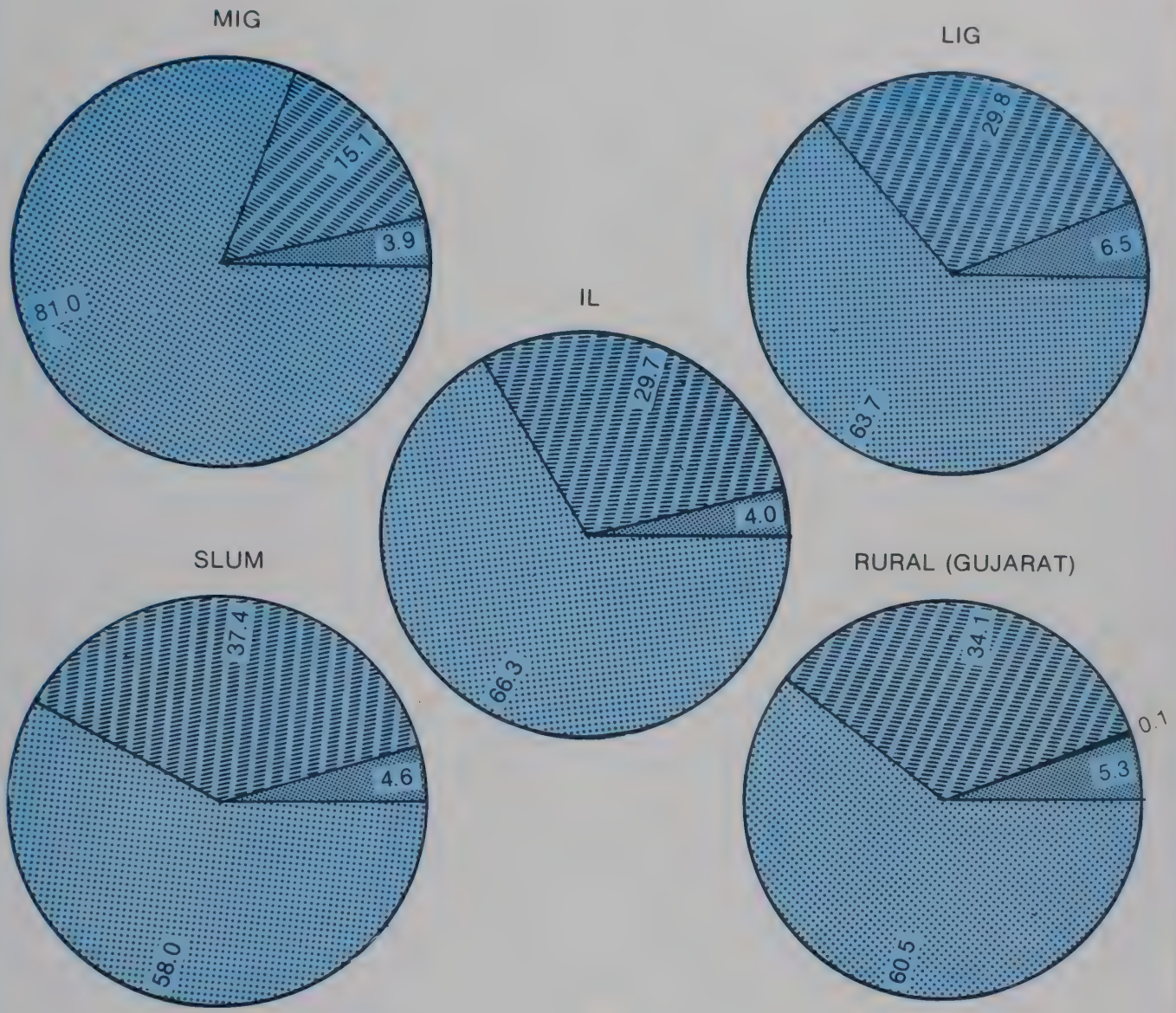
The percentage of children having normal growth status progressively decreased with decline in income status except in the case of the Industrial Labourers in whom it (percentage of normals) was higher than in Lower Income Group. Such exception however, was not seen in case of mildly malnourished children among the population groups studied. When moderate and severe degrees of growth retardation were considered, the nutrition status of children of the Industrial Labourer group appeared to be similar to that of Low Income Group.

Among the four urban groups studied, the children of Middle Income Group were the best and those of slums were the worst from the stand point of growth, and between the Low Income Group and Industrial Labourer Groups the children of Industrial Labourers appeared a shade better than those of Low Income Group. Compared to these urban children, the nutrition status of their rural counterparts was unsatisfactory as evidenced by the relatively less number of normals (9.8% against 10.3% in urban slums) and more number of severely malnourished children (9.4% as against 8.1% in slums).

Calorie-Protein Intake

In the Middle Income Group, diets of 81% of individuals was adequate in both calories and proteins. These figures in respect of the other urban groups ranged from 58% (slum dwellers) to 66.3% (IL Group). On the whole, the dietary status of the Industrial Labourers was second to MIG, followed by LIG, rural and slum dwellers in that order.

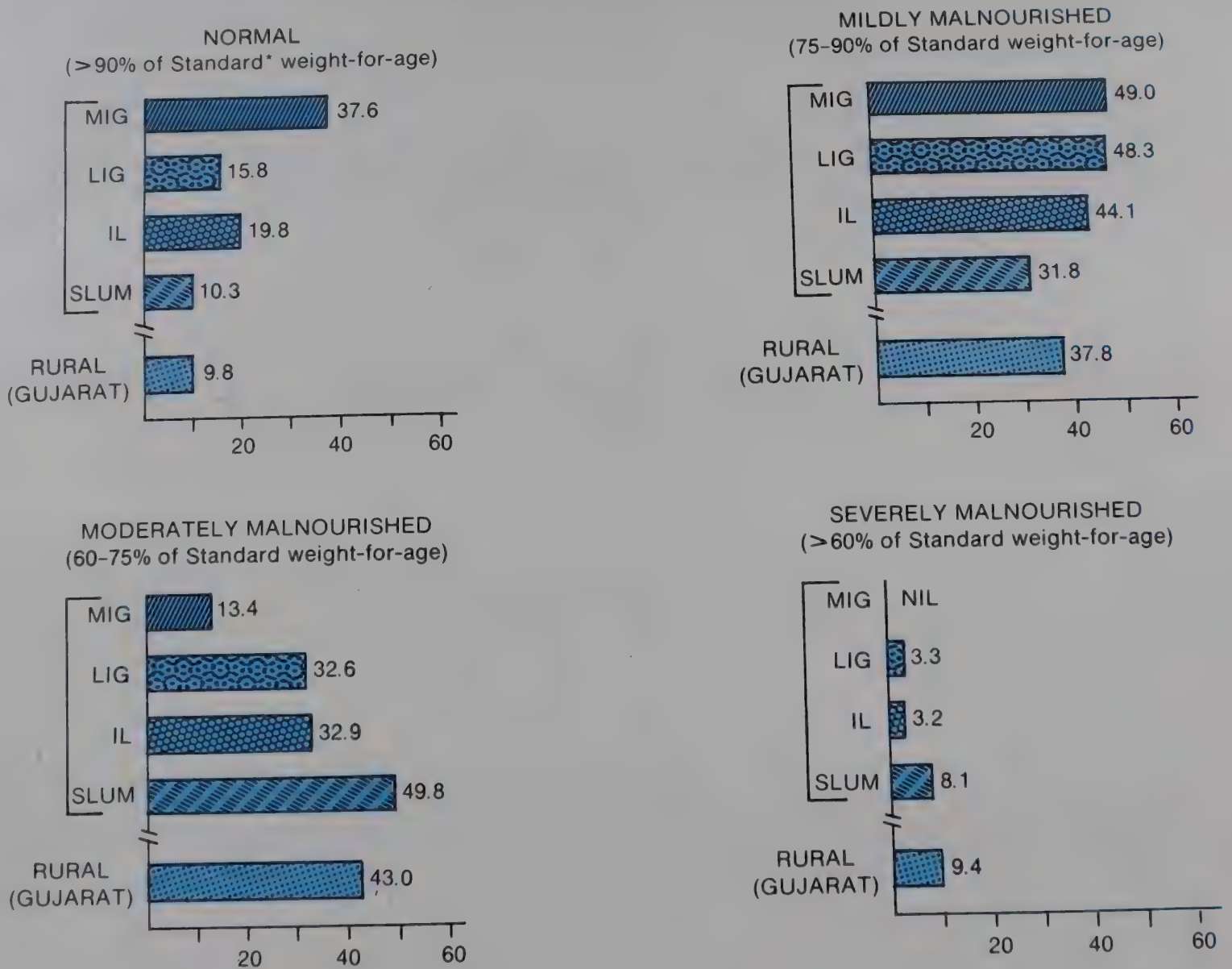
CALORIE-PROTEIN INTAKE STATUS OF INDIVIDUALS (PERCENTAGE) FROM DIFFERENT SOCIO-ECONOMIC GROUPS IN AHMEDABAD (GUJARAT)
(Source: NNMB Surveys, 1975-80)



Note: Among the individuals surveyed in MIG, LIG, IL and SLUM groups, there was none falling in the P- C+ category.

Number of Individuals Surveyed in High Income Group (HIG) was small for Analysis

PERCENTAGE DISTRIBUTION OF CHILDREN (1-5 Yrs) in AHMEDABAD (GUJARAT)
ACCORDING TO GRADES OF MALNUTRITION
(Source: NNMB Surveys, 1975-80)



Number of Children surveyed in High Income Group (HIG) was small for Analysis

*Standard: Well-to-do Indian children.

MIG : Middle Income Group IL : Industrial Labourers LIG : Low Income Group

tosis' and kill them with the help of various intracellular bactericidal systems. These activities of neutrophils are shown to be impaired in children with kwashiorkor and marasmus.

Humoral immune responses however, do not show a uniform pattern. Although the lymphocyte count and total immunoglobulin levels were found unchanged in malnutrition, the response to challenge with various vaccines was different. Diphtheria and tetanus toxoid produced satisfactory antibody response while the response to administration of TAB vaccine was poor. Differential response to viral vaccines also was noticed.

The other humoral factors like complement and lysozyme, and secretory IgA which imparts mucosal resistance were all found to be decreased in children having severe PEM. Certain pathogens such as those causing tuberculosis, leprosy and certain viruses, fungi etc. thrive intracellularly after being phagocytosed. Cell mediated or cell-to-cell interaction is essential in handling such pathogens.

Cell mediated immune reactions measured by the number of circulating T lymphocytes, and the proliferative response are impaired in children suffering from severe PEM. Macrophages are non-specific but important cells carrying out host resistance reactions. In addition to their phagocytic and bactericidal activities, they initiate and execute the cell-mediated immune reactions. They help T cell stimulation suitably presenting the antigen and by elaborating a soluble mediator Interleukin-I (IL_1) which is further essential for T cell proliferative response.

Normally macrophages are mobilised to the site of infection 24 hours after the initiation of the inflammatory response. They are metabolically activated and prevented from moving away from the site of infection by the macrophage migration inhibitor factor. Experiments have shown that in severe PEM mobilisation of macrophages to the site of inflammation was poor. Besides this, the macrophages obtained from children with kwashiorkor and marasmus were found to be defective in synthesizing Interleukin.

Effect of milder grades of PEM on the immune response :

All these observations indicate that immune function is grossly impaired in severely malnourished children. However, children with clinical forms of PEM like kwashiorkor and marasmus do not exceed 2-3% of the child population while majority of the children in the community suffer from milder grades of malnutrition manifesting as growth retardation. The functional status of the immune system of these children assumes public health relevance in developing countries where these children form the main beneficiaries of mass vaccination programmes. The humoral as well as CMI responses were found to be satisfactory in these children suggesting that they can mount adequate immune response to vaccines administered. This observation is of public health significance because control of infections is a major component in the programmes oriented towards control of malnutrition in developing countries.

How to break the vicious cycle ?

Though the interactions between malnutrition and infection are extensively worked out, it is often difficult to establish a cause and effect relationship between the two, especially in communities where both are widespread and coexistent.

Programmes planned to prevent malnutrition in the developing world should be aimed at breaking this vicious cycle. Prevention and control of communicable diseases has a major role in preventing malnutrition. Nutritional supplements would perhaps achieve the desired beneficial results when metabolic disturbances caused by infections are prevented. Control of diarrhoeal diseases involves improving the environmental sanitation, providing clean drinking water and health education regarding personal hygiene. Routine vaccinations against measles, whooping cough and tuberculosis prevent the morbidity contributed by these infectious diseases. Nutrition and health education regarding the weaning and feeding practices of infants, the importance of utilising the available medical and health care facilities at the earliest period of the child's sickness will certainly have a significant contribution in breaking the vicious cycle.

- Dr. P. Bhaskaram

RESEARCH NOTES

HEPATIC DRUG METABOLIZING ENZYMES IN UNDERNOURISHED MEN

Drug metabolizing enzymes are known to metabolize drugs and carcinogens to active and toxic substances which can be later detoxified. The influence of the nutritional status of the individual on the hepatic drug metabolizing enzymes in human wedge biopsy liver samples was investigated. The activating enzyme system Aryl Hydrocarbon hydroxylase (AHH) was found to be elevated in undernourished subjects, but the cytochrome P450 levels were not altered. The conjugating enzymes UDP glucuronyl transferase (UDPGT) and glutathione-S-transferase (GST) were not significantly different in the undernourished compared to wellnourished subjects. The observed increase in the ratios of AHH activity to that of UDPGT and GST activity suggests an increase in activation compared to deactivation mechanisms. The results suggest that the undernourished may be more prone to develop toxicity either to drug or pre-carcinogens.

NUTRIENT COMPOSITION OF OKRA SEEDS

Dried, mature seeds of the common vegetable Ladies finger (Okra, Hibiscus esculentus) can be used as a food source of protein and oil. Whole Okra seeds and their kernels have protein (21%,39%) and fat (19%,37%) respectively. These nutrients are concentrated in kernal while seed coat or hull is rich in crude fibre. Its essential amino acid composition is nearly as that of WHO/FAO reference pattern, 1973 but lower than that of whole egg protein and its chemical score is found to be 67.

Diets containing whole seed and kernel protein at 10% level were fed to weanling rats both in raw and cooked form for 4 wks. Dry matter digestibility and protein digestibility of whole seed diets were significantly lower than kernel diets, indicating that dietary fibre and the heat labile antinutritional factors in the seeds hinder protein utilisation.

These difficulties can be easily overcome by removing seed coat and cooking the kernels before consumption. PER and NPU value for the cooked kernel were similar to that of casein.

CARBOHYDRATE METABOLISM IN PREGNANCY

Pregnancy is usually considered as diabetogenic and glucose tolerance curves are generally impaired in majority of the pregnant women during the last trimester of pregnancy. Whether chronic low-calories intake of the undernourished Indian pregnant women has any influence on carbohydrate metabolism is a matter of speculation. To study this, fasting blood glucose was determined in 422 women during different trimesters of pregnancy. Anthropometric data on these women were also recorded. In a sub-sample, glucose tolerance test was also performed. Twenty non-pregnant women were used as control for this study.

Fasting plasma glucose in pregnant women showed a progressive decrease upto 28 weeks of gestation. Free Fatty Acid and Insulin/glucose ratio showed a progressive increase. The hyperinsulinemia observed in the present study in the low income group women subsisting on low calorie diet, could be an adaptive mechanism to mobilize glucose from its sources. The observed values between plasma insulin levels and fatfold thickness at triceps were also found to have a correlation.

No information is available on the role of undernutrition in fasting blood glucose or glucose tolerance in low income group non-pregnant non-lactating women. Earlier rural study dealt with only glycosuria and many women had glycosuria because of long duration of lactation. Studies are being contemplated in upper income group population (both pregnant and non-pregnant).

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NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL. 6 No. 5 SEPT 1985

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CURRENT TOPIC

VITAMIN B RESPONSIVE SKIN LESIONS - MOLECULAR BASIS

For many years it has been known that experimental or clinical deficiency of vitamin B_2 and B_6 bring about skin changes in animals and man. In humans, the deficiency of these vitamins produces typical lesions of the tongue (glossitis), corners of the mouth (angular stomatitis) and nasal folds (nasolabial dyssabacea). In most subjects these lesions respond to treatment with riboflavin (vitamin B_2), but sometimes supplements of other B vitamins help complete recovery. It was earlier observed that in some subjects the oral lesions improve with therapeutic doses of vitamin B_6 (pyridoxine) only, or B_6 in combination with B_2 (Iyengar & Krishnaswamy, NIN).

BIOCHEMICAL RELATIONSHIP BETWEEN VITAMIN B_2 AND B_6 :

We have recently investigated the problem of interrelationship between riboflavin and pyridoxine, and the biochemical basis of the skin lesions which respond to one or a combination of these two vitamins (Bamji, Laxmi and Rajani Prasad, NIN).

In the body, the B-complex vitamins are converted to active derivatives called coenzymes, which perform the functions of these vitamins as natural catalysts of biochemical reactions. For the conversion of pyridoxine to its active coenzyme called pyridoxal phosphate (PLP), riboflavin is necessary. Therefore impaired conversion of pyridoxine to its active form PLP would be an expected consequence of riboflavin deficiency. The studies conducted at the NIN showed that in riboflavin deficiency the activity of the enzyme pyridoxine phosphate oxidase (PPO) is markedly reduced and the conversion of pyridoxine to PLP is significantly affected. In other words riboflavin deficiency impairs the optimal utilisation of pyridoxine. Based on these observations it was postulated that the vitamins B_2 and/or B_6 responsive skin lesions may be due to cellular deficiency of PLP, the active derivative of pyridoxine. The next question was, why should cellular deficiency of PLP give rise to skin lesions ?

COLLAGEN INVOLVEMENT :

Collagen is an important structural protein of the skin. It is present in the dermal and basal membrane layers which lie beneath the top layer called epidermis. Structurally, collagen molecule is composed of three chains of amino acids coiled like helix and stabilised by crosslinks between the chains within and between molecules, giving rise to collagen fibres. Collagen is synthesised in cells called fibroblasts. Newly synthesised collagen molecules do not have any crosslinks, and are easily soluble in dilute salt and acid solutions. The crosslinking occurs after the collagen is secreted out of the fibroblasts. It is initiated by an enzyme called lysyl oxidase. This enzyme has been known to require copper as a cofactor. Copper deficiency has been reported to reduce lysyloxidase activity, impair collagen crosslinking and produce skin and bone changes in animals.

A few years ago, it was observed that besides copper, PLP is also a cofactor for lysyl oxidase. The activity of lysyl oxidase is reduced in the aorta and cartilage of pyridoxine-deficient chicks (Bird and Levene, 1982). Based on the above discussed relationship between vitamins B_2 and B_6 and the requirement of B_6 for lysyl oxidase activity, it was hypothesised that the skin lesions of vitamins B_2 and/or B_6 deficiency may be due to impaired collagen crosslinking and maturity.

To verify this hypothesis, the effects of vitamins B_2 or B_6 deficiency on the metabolism and properties of rat skin collagen were examined. Groups of weanling male rats, were fed either a control diet or a similar diet but deficient in either riboflavin (vitamin B_2 deficiency) or pyridoxine (vitamin B_6 deficiency). To discriminate between the effects of growth retardation (which occurs in any nutritional deficiency) and the specific effects of vitamin deficiency, one group of rats was fed the control diet in restricted amounts so that their growth was similar to that of the vitamin-deficient rats. A range of biochemical, biophysical and biomechanical properties of the skin such as solubility in salt and acid solutions, susceptibility to denaturation, tensile strength etc, were examined. The results showed that in vitamin B_2 or B_6 deficiency, the collagen content of the skin is reduced, and its properties show alterations suggestive of reduced crosslinking. While these studies were in progress, Fuji and coworkers from Japan produced direct evidence for reduced collagen cross-linking in the skin of vitamin B_6 - deficient rat. Such direct evidence for riboflavin deficiency is yet to be obtained, but the indirect evidence based on the properties mentioned above is quite convincing. Food restriction produced similar effects but of significantly lower magnitude.

Collagen synthesis in the skin of riboflavin deficient rats was examined by measuring the incorporation of the amino acid proline labelled with tritium. Proline is one of the 20 amino acids that form the building blocks for all the proteins. However,only in collagen, some proline molecules are converted into hydroxyproline. Thus, the tissue and urinary levels of hydroxyproline are useful indices of collagen content and metabolism. These studies using radioactive proline suggest that in the deficiency of riboflavin, collagen synthesis is impaired. Again food restriction has similar effect, but of lower magnitude.

The above mentioned studies thus support the hypothesis that the biochemical/molecular basis of the skin lesions of vitamin B_2 and/or B_6 deficiency may be, impaired cross-linking and maturity of skin collagen. Such a change would weaken the dermis and the basal membrane and make the overlying epidermis susceptible to stress and infections

CENTRE-SPREAD

Data presented in the centrespread pertain to the growth status (Gomez Classification, weight-for-age) of 1-5 year old children and the dietary status (in terms of calorie-protein adequacy) of individuals belonging to the different socio-economic groups of urban population in Bangalore City (Karnataka). The urban data are compared with those obtained on rural counterparts of Karnataka.

GROWTH STATUS OF URBAN PRESCHOOL CHILDREN :

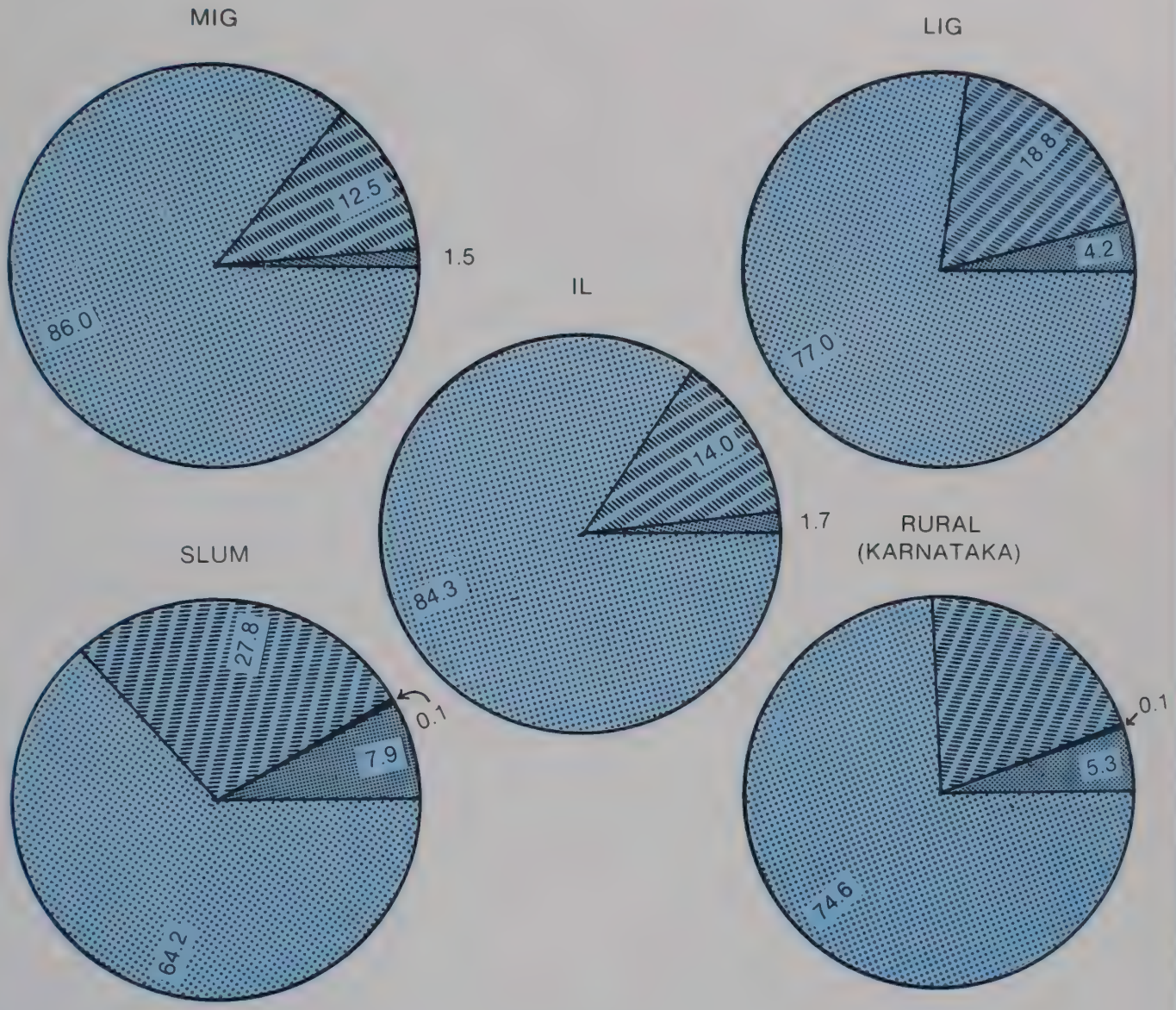
The percentage of children having normal growth progressively decreased with decline in income status, except in the case of the Industrial Labourers in whom percentage of normals was higher than in Lower Income Group. The reverse was the trend in the case of percentage of severely malnourished children where percentage of such children increased with decreasing income status. However, in the case of mildly malnourished children among the population groups studied LIG registered a higher percentage than Industrial Labourer Group. When moderate degree of growth retardation was considered, the nutritional status of children of the Industrial Labourer Group appeared to be slightly better off than that of Low Income Group. But in the case of severe degrees of growth retardation, the nutritional status of children of the slum group was the worst.

Among the four urban groups studied, the children of Middle Income Group were the best and those of slums were the worst from the standpoint of growth, and between the Low Income Group and Industrial Labourer Groups the children of Industrial Labourers appeared a little better than those of Low Income Group. Compared to these urban children, the nutritional status of their rural counterparts was unsatisfactory as indicated by the relatively less number of normals (9.9%) which is closer to the urban slum population (9.4%).

CALORIE-PROTEIN INTAKE :

In the Middle Income Group, diets of 86.0% of individuals were adequate in both calories and proteins. These figures in respect of the other urban groups ranged from 64.2% (slum dwellers) to 84.3% (IL group). On the whole, the dietary status of the Industrial Labourers was second to the MIG, followed by LIG, rural and slum dwellers in that order.

CALORIE PROTEIN INTAKE STATUS OF INDIVIDUALS (PERCENTAGE) FROM DIFFERENT SOCIO-ECONOMIC GROUPS IN BANGALORE (KARNATAKA)
(Source: NNMB Surveys, 1975-80)



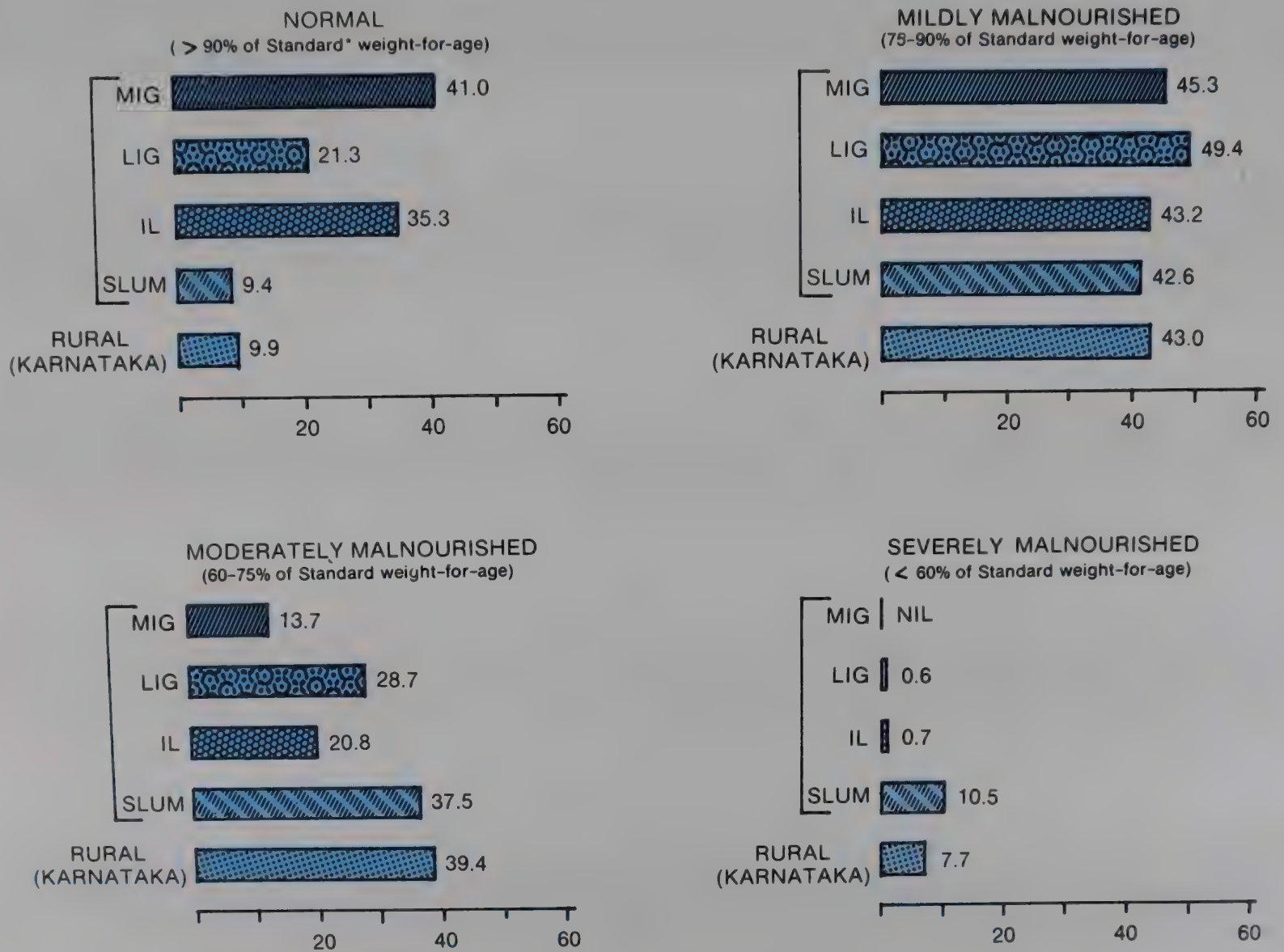
P : PROTEIN
C : CALORIES

\+ : ADEQUATE
— : INADEQUATE

MIG : MIDDLE INCOME GROUP LIG : LOW INCOME GROUP IL : INDUSTRIAL LABOURERS

Number of Individuals Surveyed in High Income Group (HIG) was small for Analysis

PERCENTAGE DISTRIBUTION OF CHILDREN (1-5 YRS) IN BANGALORE (KARNATAKA) ACCORDING TO GRADES OF MALNUTRITION
(Source: NNMB Surveys, 1975-80)



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particularly in areas such as tongue and the corners of the mouth which are exposed to constant stress. The observation that the food restricted control rats also suffer some impairment, is in line with the observation that the oral lesions are more commonly seen in women whose diets are deficient in calories (Prema, NIN). Food restriction may be an additional predisposing factor for precipitating oral lesions in vitamins B_2 and B_6 deficient subjects.

- Dr. M.S. Bamji

RESEARCH NOTES

IMPACT OF ORIENTATION IN NUTRITION TO CHVS

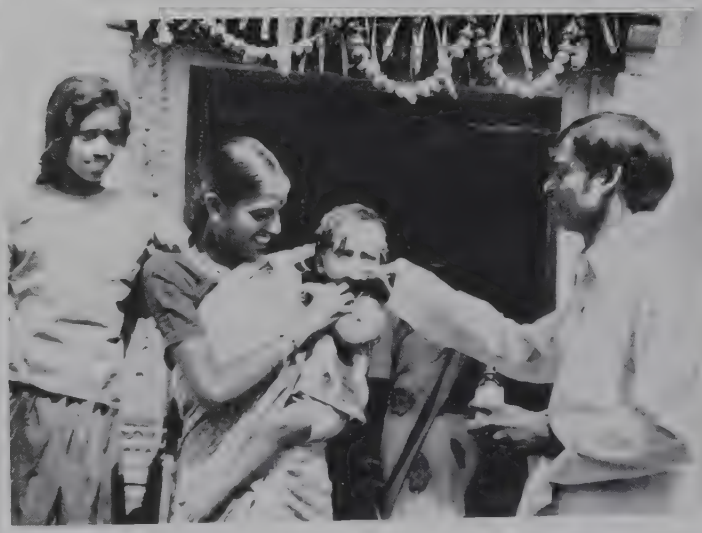
A study was undertaken in two Primary Health Centres near Hyderabad to assess whether orientation training in nutrition to Community Health Volunteers (CHVs) would result in improved knowledge and performance as far as nutrition services and their delivery are concerned. In each Primary Health Centre (PHC), 50 CHVs were randomly selected. They were further allocated randomly into two batches of 25 each, experimental and control. While the experimental group was given orientation in nutrition, the control group did not receive any such training. In one of the Primary Health Centres (PHC-1) a short refresher training course was organised every month for CHVs during their monthly meetings at the PHC Headquarters for a period of 12 months, while in the PHC-2, no such courses were organised.

It is clear from the data obtained that the knowledge scores in both the PHCs were higher at both points of contact i.e. after 6 months and 1 year of training as compared to the controls. At the end of 1 year in the PHC-1, where monthly refresher training course was provided, the CHVs scored higher marks than their counterparts in PHC-2 where no refresher courses were offered, indicating thereby that continuing education leads to better knowledge of the functionaries.

The diagnostic capabilities of the CHVs were assessed by a process of verification of clinical cases by trained investigators through home visits. The results indicated that almost all the cases suffering from Protein Energy Malnutrition (PEM), vitamin-A deficiency, B-complex deficiency, were correctly diagnosed by the experimental groups of CHVs, while this was not so in control group of CHVs in both the PHCs. Before the training, the diagnostic capabilities were rather poor. In the case of non-nutritional conditions, the baseline score itself was higher and there were no differences, however, between the experimental and control groups.

These results seem to suggest that the erstwhile training of CHVs in diagnosing non-nutritional conditions of diarrhoea and fever was satisfactory, whereas in detecting cases of malnutrition, it was quite unsatisfactory and warranted special orientation training in nutrition.

One of the important functions of the CHVs is to impart nutrition education to communities. An assessment of the function indicated that only a very small percentage (about 19%) of the community members reported that the CHVs did talk of special dietary needs of pregnant women and young



children, supplementary feeding to children and relationship of common nutritional disorders to the diet. In the control areas however, this percentage was even smaller (5%). The percentage of community members reporting that 'nutrition education was given' was higher in PHC-1 as compared to PHC-2.

There was no difference in the knowledge of community members with reference to some of the important aspects of nutrition, such as the age of introduction of supplements, causes of night blindness and PEM, and the ongoing massive dose vitamin A programme both in the control and experimental areas suggesting lack of impact of education.

These results indicate that the orientation courses no doubt resulted in improvement of nutrition knowledge of the Community Health Volunteers and their abilities to diagnose nutrition disorders, but they did not result in the improvement of community perception which was expected to be brought about by the educational efforts of the CHV. Follow-up supervision and close monitoring, perhaps, may help in developing this aspect of CHV functioning.

CHILD LABOUR AND UNDERNUTRITION

A sizable number of growing children of poor socio-economic group in rural areas are known to be inducted as child labour at some stage or the other. Since the physical labour is likely to impose additional stress on the growing child, the relationship between physical stress and growth of such children was studied.

For this purpose, the longitudinal growth data (from 5th year to young adult stage) available over 15 years on 410 boys were analysed according to their work status during the ages of 10-14 years. Of the 410 boys, 213 were engaged as child labour during 10 to 14 years of their ages (84 as wage earners, 76 working on their own farms, 53 as helpers in small work establishments) while the remaining 197 were students. The growth pattern of children engaged in different kinds of active physical labour (child labour) and of those not engaged in labour (i.e. students within the three early nutritional status categories) were compared.

Height for age at age 5 was used as the criterion for separation. Severely undernourished group had height values less than mean - 4 S.D. of Boston referral values. Mild and moderately undernourished group boys had height for age at 5th year between mean - 2 S.D. and mean - 4 S.D. of Boston referral values. Normal group boys had height values between mean - 2 S.D. and mean of Boston referral values. Students and wage labourers who were matched for height for age i.e. within each nutritional group were examined for growth from 5th year of life upto completion of growth. In each of the nutritional groups, child labourers always had lower growth compared to their non-working counterparts.

In the better nutritional group I & II, students achieved superior growth i.e. 5 cm in height and 3 kg. in body weight; However, in group III with severe childhood undernutrition, the differences between students and wage labourers were not significantly different. The data further indicate that the child labourers of group I slipped one step down the nutritional class suggesting that the group that was subjected to child labour could not maintain the growth, possible under their social environment for their student counterparts.

Earlier studies show that most of the deficit in adult height seen in the population could be traced to earlier (childhood) malnutrition. The present study, however, seems to suggest the possibility of physical labour (sometimes from 6 or 8 years of age) during growth period acting as one of the important stress variables (in addition to other socio-economic factors).

The social determinants of severe childhood undernutrition may also influence the growth status of children and their occupation when they are growing. Further research is needed to determine the influence of social variables like caste and class, economic variables like land holdings, employment status of parents and housing pattern, along with the early nutritional plane and occupational category of children on the adolescent growth pattern and adult nutritional status of boys.

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NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL 6. No.6 NOV 1985

CURRENT TOPIC

Nutritional Significance of Rice Bran Oil

India's demand for vegetable oils is continuing to increase faster than production rates necessitating a slowly rising level of imports of vegetable oils. Vegetable oil consumption for 1984 was estimated at 4.5 million metric tonnes (MT) against production at 3.2 million MT with an import of 1.3 million MT. For 1985 the forecast has been a consumption figure of 4.6 million MT with a production of 3.5 million MT and imports totalling to 1.4 million MT. These consumption figures work out to a per capita consumption of about 17.5 g/day against 35 g per capita per day recommended by ICMR for a balanced diet. Hence there is an increasing interest in developing new indigenous sources of oils and fats.

Non-traditional sources

Several unconventional oils have been investigated at the National Institute of Nutrition (NIN) to ascertain the safety of their consumption, following a comprehensive and systematic protocol designed according to the food safety regulations of WHO/FDA/DGHS/EEC. It involves several aspects including chemical analysis of the fat, its nutritional evaluation and toxicological safety by multigeneration breeding studies in rats.

Unconventional oils such as oils from mango kernel, Cleome viscosa, mesta, Terminelia bellerica, neem, rice bran, kapok and mahua have been investigated in NIN for their safety following the above designed protocol. Of these, mango kernel oil, Cleome viscosa oil and rice bran oil have a very promising future as edible oils. Mango kernel oil is found to be a safe substitute for cocoa butter fat. Presently, cocoa butter fat is very much valued in confectionary and bakery industry and the government spends a lot of foreign exchange in importing it. Cleome viscosa oil has 70% linoleic acid and it has been found to be safe as an edible oil and can bridge the deficit to some extent, if properly exploited.

Oil from rice bran

India, today, is the second largest producer of rice bran oil in the world. The potential for production of rice bran oil has been estimated at 0.6 million tonnes per annum and there is a scope to increase the production further by improved technology. But currently only 1.5 lakh tonnes of rice bran oil is being produced, of which 15,000 tonnes are of edible grade. Japan, with rice production at less than 20% of that of India, produces one lakh tonnes of edible grade rice bran oil per annum.

One of the major problems of exploiting rice bran for extraction of edible grade oil is its high lipase activity. Several chemical methods were tried but all of them suffer from such disadvantages as high cost, chemical residue effect etc. Dry or wet heat has been found to inactivate the enzyme quite efficiently as is being done in Japan. A new chemical method involving treatment with hydrochloric acid has been developed by CFTRI, Mysore, which (takes 2-3 minutes and does not require steam or electricity) can be operated at a very low cost at the huller mill itself.

There are two main disadvantages of rice bran oil which make it unfit for edible purpose. Rice bran oil has high Free Fatty Acids (FFA) and high unsaponifiable fraction. The Central Committee of Food Standards has stipulated that the unsaponifiable fraction of an edible oil should be less than 3%. Rice bran oil always has unsaponifiable matter of the order of 4-5%.

Nutritional and toxicological evaluation

Edible grade rice bran oil was evaluated in this Institute for chemical composition, nutritive value and toxicological safety. Chemically, the composition of rice bran oil is very close to that of groundnut oil. Both

the oils contain about 35% linoleic acid, which is an essential fatty acid. There are no other abnormal or toxic components present in the oil.

Multigeneration breeding studies in rats fed 10% rice bran oil in a 20% protein rich diet adequate in all nutrients have revealed that the fat in the diet (a) promoted active growth (b) had good nutritional quality as judged by various parameters (c) resulted in good reproductive performance (d) had no mutagenic or teratogenic effects when compared with rats fed similar diets containing groundnut oil.

The nitrogen, phosphorus and calcium balance were also found to be unimpaired due to the presence of this fat in the diet. In addition, rice bran oil showed marked hypocholesterolemic activity when compared to groundnut oil though both the oils contain similar levels of linoleic acid. Linoleic acid is known to bring down the cholesterol and triglycerides levels in the serum and liver.

A separate experiment was devised to confirm the hypocholesterolemic activity of rice bran oil by feeding rice bran oil and its various fractions to groups of rats. Rats fed rice bran oil at 10% level for a period of 8 weeks showed significantly lower levels of total cholesterol, LDL+ VLDL cholesterol, both on cholesterol-rich and cholesterol-free diets. HDL cholesterol was raised and triglycerides showed a tendency to decrease. Faecal excretion of neutral sterols and bile acid was higher after ingestion of rice bran oil. The unsaponifiable fraction of rice bran oil in the diet also showed similar effects.

Hypocholesterolemic activity of various edible oils

Edible oil	Linoleic acid content	Cholesterol level
Safflower oil	77.1	- 16
Sunflower oil	61.4	- 12
Cotton seed oil	58.0	0
Soya bean oil	50.2	+ 3
Sesame oil	45.9	+ 2
Corn oil	43.0	- 15
Rice Bran oil	36.0	- 17
Groundnut oil	35.0	+ 5

CENTRE-SPREAD

Data presented in the centrespread pertain to the growth status (Gomez Classification, Weight-for-Age) of 1-5 year old children and the dietary status (in terms of calorie protein adequacy) of individuals belonging to the different socio-economic groups in Trivandrum City (Kerala). The urban data are compared with those obtained on rural population of Kerala.

Growth status of preschool children

About one-third of the children in MIG, LIG and IL groups had normal growth status. Among the children of urban slums and rural areas, nearly one-in-five and one-in-six children respectively were found to have normal growth.

When children with Moderate-to-Severe degrees of growth retardation were considered, one-in-six of the LIG and IL groups, one out of five in MIG and one out of four among slums were found to fall in these categories. Slightly more than one third of the children belonging to rural areas, showed Moderate-to-Severe degrees of growth retardation.

Children with severe growth retardation were about 3% in LIG, which was nearly double that observed in slums and four times as compared to IL group. This figure for rural Kerala was 4.8%.

Calorie-Protein Intake

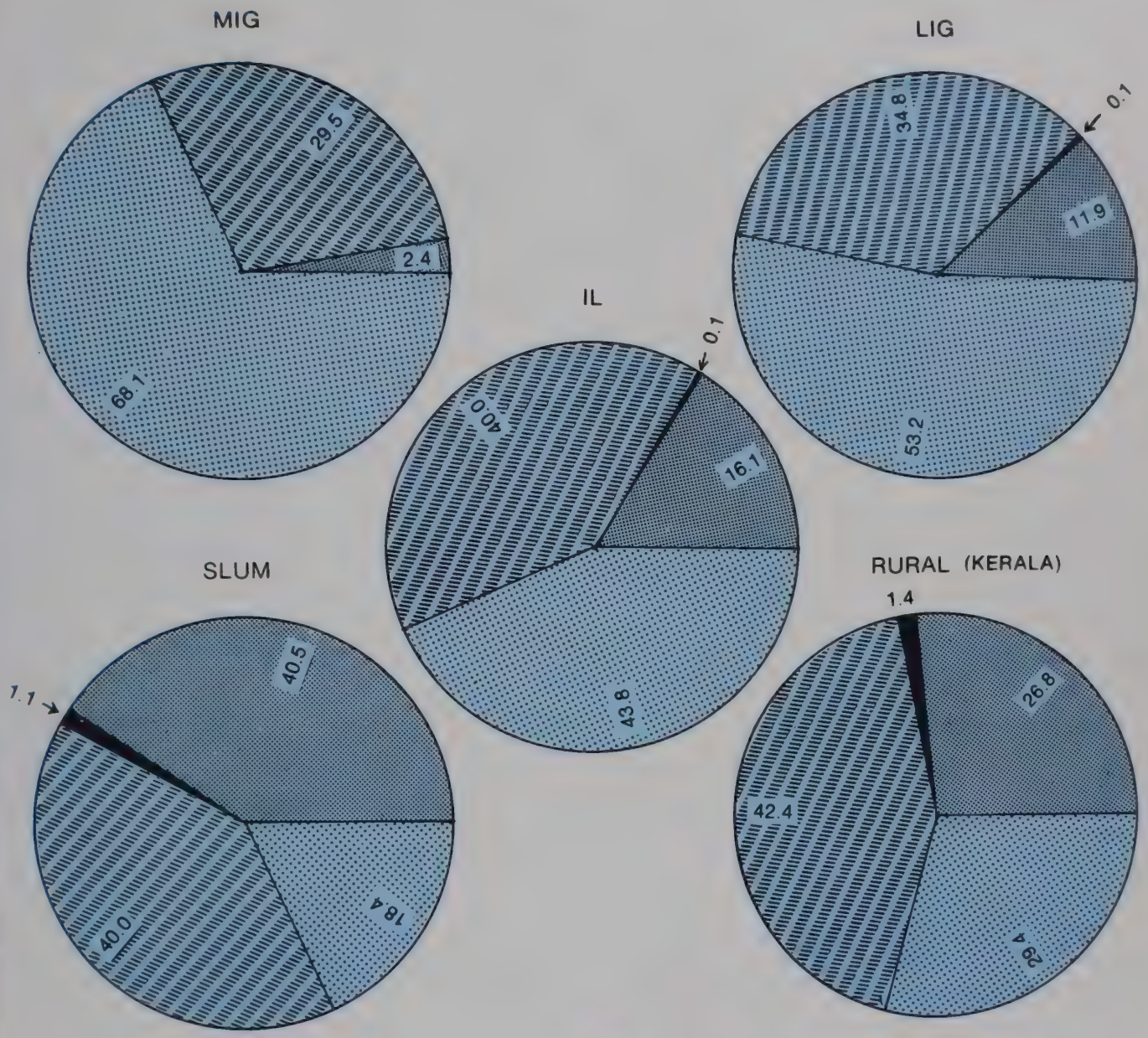
Sixtyeight per cent of the MIG were consuming adequate amounts of calories and proteins in their diets. The corresponding figures among LIG, IL and rural populations were 53%, 44% and 29% respectively. Only 18% of the slum dwellers were found to consume diets adequate in both calories and proteins.

From the table it can be seen that rice bran oil has highest hypocholesterolemic activity though the linoleic acid content is in the lowest range. Experiments conducted in NIN revealed that liver and serum cholesterol and triglycerides in rice bran oil fed (10% level) group were much lower than those in safflower oil fed (10% level) group, indicating that rice bran oil is even better than safflower oil in lowering the cholesterol.

Various blends of safflower oil and rice bran oil were fed to human volunteers (Suzuki *et al.*, 1984) and it has been reported that a blend of rice bran oil and safflower oil in the ratio of 7:3 provides the most effective lowering action because of the combination of high linolenic acid in safflower oil and the unsaponifiable fraction of the rice bran oil.

CALORIE PROTEIN INTAKE STATUS OF INDIVIDUALS (PERCENTAGE) FROM DIFFERENT SOCIO-ECONOMIC GROUPS IN TRIVANDRUM (KERALA)

(Source : NNMB Surveys, 1975-80)



P : Protein C : Calories

+: Adequate –: Inadequate

P – C –

P+ C–

P - C +

P+C+

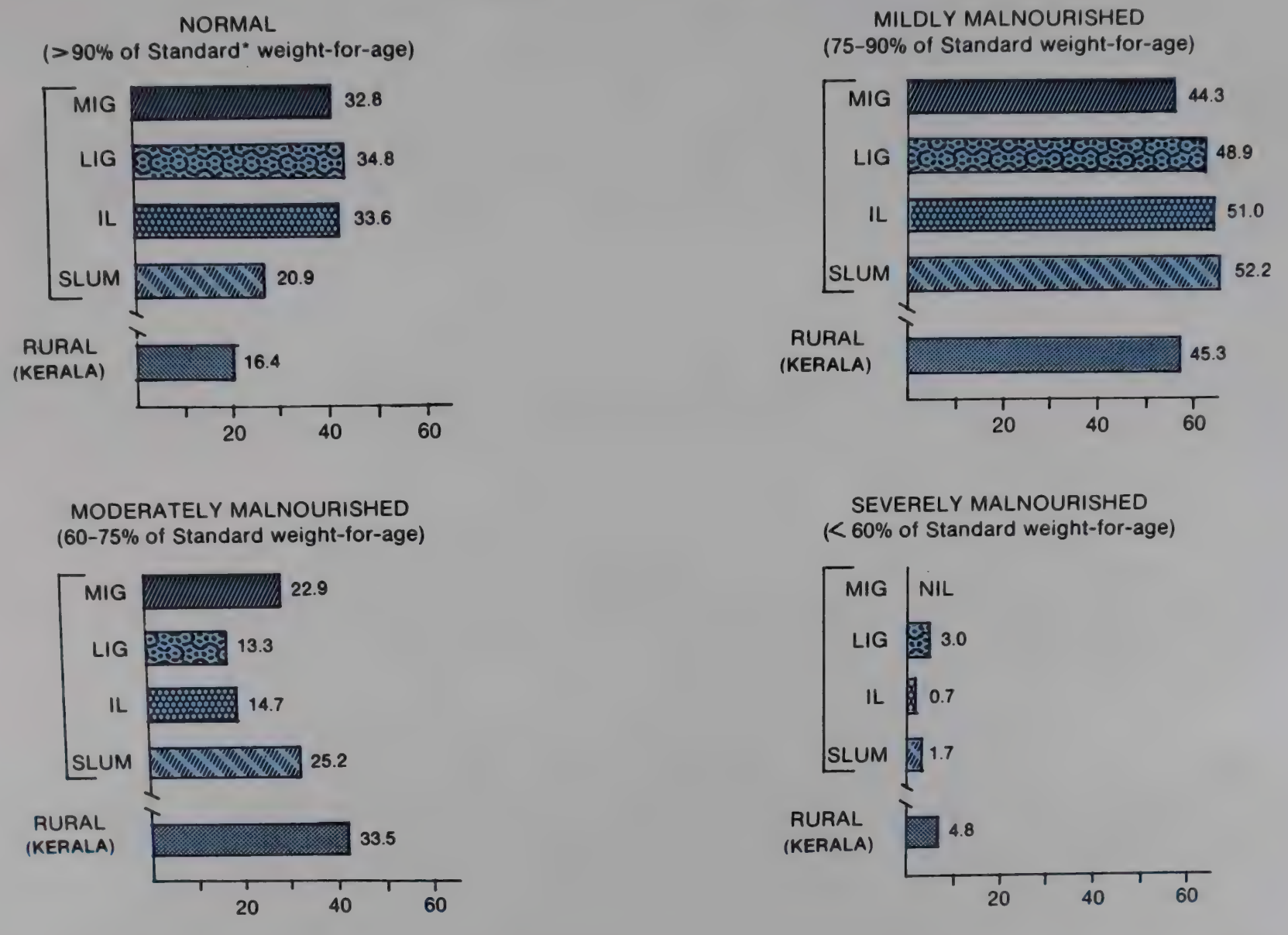
MIG : Middle Income Group LIG : Low Income Group IL : Industrial Labourers

Note: Among the individuals surveyed in MIG, group , there was none falling in the P– C+ category.

Number of Individuals Surveyed in High Income Group (HIG) was small for Analysis

PERCENTAGE DISTRIBUTION OF CHILDREN (1-5 YRS) IN TRIVANDRUM (KERALA) ACCORDING TO GRADES OF MALNUTRITION

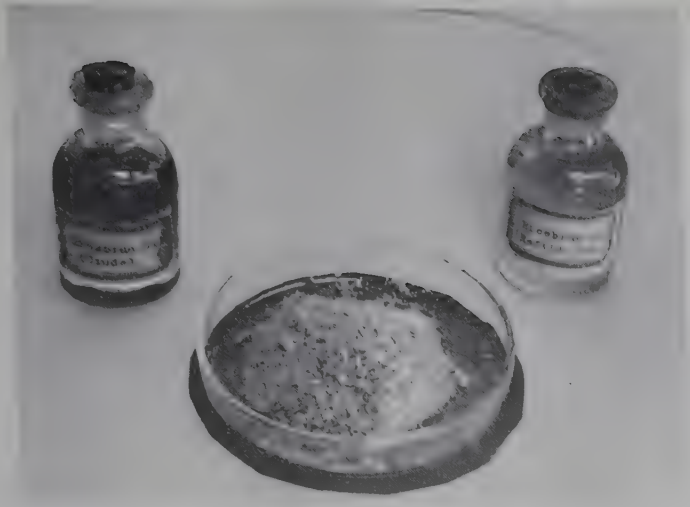
(Source: NNMB Surveys. 1975-80)



Number of Children surveyed in High Income Group (HIG) was small for Analysis

*Standard: Well-to-do Indian children.

MIG : Middle Income Group IL : Industrial Labourers LIG : Low Income Group



Advantages

Apart from these nutritional qualities, rice bran oil has some more advantages. The oil contains high levels of tocopherols (vitamin E) which gives oxidative stability to the oil. It is toxicologically safe for human consumption. It has higher squalene content than all known oils a characteristic known to be good for maintaining the integrity of skin. The keeping quality of the oil also rates high when compared to other oils. Foods deep-fried in rice bran oil showed that the oil is less absorbed or consumed in fried foods when compared with foods fried in groundnut oil. The fried foods were evaluated for the presence of mutagens by Ames mutagenicity assay. Our experiments showed that neither rice bran oil nor the foods fried in it have any mutagenic effects in the bacterial screening system. The organoleptic studies of the foods fried in rice bran oil also revealed the good acceptability of the products.

- Dr. C. Rukmini

RESEARCH NOTES

INTERLEUKIN-1 (IL_1) IN MALNUTRITION

Recent advances in the field of immunology have highlighted the role of macrophage (mØ) in host resistance mechanisms, particularly in supporting the T-lymphocytes in the execution of cell mediated immune responses (CMI). *In vitro* studies have demonstrated that the action of macrophage is mediated through macrophage derived factors which can essentially substitute for the parent cell in supporting the lymphocyte cultures. Lymphocyte activation factor which has been designated interleukin-1 (IL_1) is found to be the essential macrophage derived mediator. This provides a maturational signal to antigen or mitogen primed T lymphocytes and thus leads to the elaboration of interleukin-2 (IL_2) necessary for the amplification of CMI response.

The adverse effects of malnutrition on cell mediated immune system are so far understood to be due to defective T cell function. Recent clinical studies from NIN have established the impairment of macrophage function in malnourished children as indicated by lowered opsonic activity in serum leading to altered bactericidal activity and decreased chemotaxis of monocytes *in vivo*.

The effect of malnutrition on the *in vitro* production of IL_1 by lipopolysacharide stimulated macrophages has been investigated in children suffering from kwashiorkor and marasmus.

The results indicated the possible presence of a mØ derived suppressor factor, in addition to decrease in IL_1 activity in children with severe PEM. The decrease in IL_1 activity might be due to decrease in synthesis or exhaustion following *in vivo* release of the factor consequent to recurrent infections. The nature of the mØ derived supressor factor is however not clear.

These data explain the role of mØ in contributing to suppression of CMI responses in malnutrition.

DIETETICS IN INDIAN HOSPITALS

In order to assess the prevalent situation of diet and dietetic departments in the hospitals of the country, a questionnaire was mailed to 248 hospitals selected from the Directory of hospitals. Only 29% of the hospitals responded. Analysis of the data revealed that in about one half of the hospitals studied, the services of the trained dietitians were not available. Availability of other supporting staff like stewards, therapeutic cooks etc. was far from satisfactory. So also, the physical facilities available for the efficient functioning of the department were found to be inadequate. Only about 11% of hospital kitchens used modern means of cooking, viz., gas or electricity. Running water was reported to be present in almost all the hospitals.

Both general and therapeutic diets were being supplied in these hospitals. Evaluation of nutritive value of the general diet suggested that they provided enough protein, calcium, thiamine and iron, but fell short of recommended allowance (RDA for sedentary

male 1981) in case of calories, vitamin A and riboflavin. The studies indicated the scope for improving the dietetic department in Indian hospitals.

MEETINGS

X International Vitamin A Consultative Group Meeting

The X IVACG Meeting was held between 14th and 18th October 1985 at the National Institute of Nutrition, Hyderabad. His Excellency Dr. Shanker Dayal Sharma, Governor of Andhra Pradesh, inaugurated the meeting. Prof. V. Ramalingaswami, Director-General, Indian Council of Medical Research, New Delhi, presided over the meeting.

Around 100 delegates including 70 foreign and 30 Indian attended the meetings. Apart from scientists, administrators and representatives of international bodies like WHO, UNICEF, USAID involved in the implementation of public health programmes for the control of vitamin A deficiency took part in this meeting.

The meeting was divided into the following sessions :

(a) Vitamin A and Infection - (i) Measles (ii) Diarrhoea (iii) Chickenpox (iv) Trachoma.

(b) Vitamin A status in relation to morbidity and mortality.

(c) Newer approaches towards assessment of vitamin A status.

(d) Nutrition Intervention Programmes.

(e) Panel discussion for Policy and Programme Implications.

The 4-day meeting recommended that :

1. There was an urgent need to determine in various parts of the world the effect of periodic dose of vitamin A in morbidity of young children. It would be useful to know the impact of vitamin A supplementation in areas of varying severity and prevalence of vitamin A deficiency.

2. Care should be taken not to give large doses of vitamin A to women of child bearing age and school age children.

3. Absorption of orally administered vitamin A into the body is still sufficient during an episode of diarrhoeal disease to warrant administration of a high dose of vitamin A.

4. The Government should aim at assuring adequate intakes of vitamin A, preferably, from normal dietary sources; steps may be taken to increase production, distribution and consumption of certain foods. Cultural factors affecting food consumption should be taken into account. Due consideration should be given to other nutrients that are also required.

Special programmes on vitamin A distribution should be integrated as far as possible with various services, including primary health care.

TRAINING PROGRAMMES

The Twentythird Annual Certificate Course in Nutrition of 3-months duration will commence from 2nd December 1985. Eleven participants including two from Defence Services, one from Railways and eight from different States of India are expected to participate.

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NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL.7 NO.1 JAN 1986

WE WISH ALL OUR READERS A HAPPY AND PROSPEROUS NEW YEAR

CURRENT TOPIC

Nutrition and Cancer

Introduction

Majority of human cancers appear to be due to environmental factors. Populations differ greatly in the pattern of cancer incidence; populations also differ widely in their dietary habits and environmental exposure. Nutritional and non-nutritional components in the diet seem to influence initiation and promotion of malignant growths.

Interrelationship between diet and cancer can be viewed from many directions. Our daily diet may serve as a source of either a direct or indirect carcinogen. It may be the route of delivery of carcinogenic substances. Food contaminants and additives may act as carcinogens and co-carcinogens. Diet may modify the *in vivo* formation of carcinogens. Nutrients and certain non-nutrients may modulate carcinogenic expression of xenobiotics through alteration in activation or detoxification of carcinogens. Nutritional status may further contribute to carcinogenesis by altering (a) host factor mediated capacity to form carcinogenic substances (b) tissue susceptibility (c) cellular proliferation and growth (d) defense mechanisms such as immuno surveillance, and (e) DNA repair which jointly are responsible for tumour or cancer growth.

A number of chemicals present in foods both natural and synthetic or those formed during cooking processes may act as mutagenic/carcinogenic substances. Food contaminants such as mycotoxins and pesticides, food additives such as food colours, flavouring agents and preservatives may further complicate the picture. Diet also has protective agents such as indoles, phenols, isothiocyanates, flavones and other anti-oxidants which may prevent chemical carcinogenesis.

Though the causes of cancer have been identified as external in origin, diet alone cannot be responsible. However, it is important to realise that diet and nutritional status can considerably influence the occurrence and cause of cancer in any population.

The Epidemiology

Though cancers are fairly easy to record in terms of either incidence or mortality, the environmental variables which are in existence before the development of the disease are difficult to quantify. Human epidemiological studies of diet as a causal factor are of different types: ecological studies, case control studies, prospective cohort studies and certain intervention studies. Correlation studies on per capita food consumption data of different countries and cancer incidence/mortality, migrant population studies and case control studies have provided important information on diet and cancer. The distribution and determinants of metabolite markers termed as a metabolic epidemiology is also gaining wide recognition in studying interrelationship between diet and cancer.

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Macronutrients

Various types of studies which have been enumerated indicate certain positive relationship between diet and cancer which are depicted in the table. There are only few epidemiological data relating to total calorie intake and cancer risk. As indicated in the table, hormone dependent cancers, high fat and protein intake and affluence are related. Till today owing to lack of proper documentation such studies in developing countries are meagre. However, recent studies by ICMR through cancer registries located in different regions in India indicate that the prevalence of oral, oropharyngeal, oesophageal and cervical cancer are high in the low socio economic groups. This is true for several other countries such as China and Iran. However, descriptive studies in relation to calorie intake are lacking. Neither the epidemiological nor the experimental studies permit a clear interpretation of the specific effect of calorie intake as risk factor for cancer due to confounding variables.

Fat intake and cancers such as breast, prostate and gastro intestinal tract have been studied in depth and all of these tend to show most striking dietary associations. Both the quantity and quality of dietary fat appear to influence malignancies. Direct associations have more often been observed with saturated fat intake. Data from animals suggest that when total fat intake is low, polyunsaturated fats are more effective in producing tumours whereas data in humans do not permit a clear distinction to be made.

A very high correlation between fat and protein intake in western diets makes it difficult to dissociate the effect. However, the evidences which exist s do not completely preclude an independent effect of protein.

The epidemiological data on fibre are related primarily to its possible role in protection against large bowel cancer.

Micronutrients

In recent years there has been considerable interest in the role of vitamins A, C, E and B vitamin in the genesis and prevention of cancer. Of all the vitamins, vitamin A deserves special attention. In cancers of lung, larynx, bladder, oesophagus, stomach, colon/rectum, prostate etc. an inverse relationship between either dietary intake or serum vitamin A levels has been observed. Both vitamin A and β-carotene seem to be having a protective effect. Based on these observations, synthetic retinoids are being used to control tumour growth. Most of the vitamins seem to be acting either through inhibition of formation of carcinogen, or by protecting against free radicals. Among minerals and trace metals, iron, zinc and selenium deficiency seem to increase the risk of cancer. Studies at NIN indicate that both oral and oesophageal cancer subjects have a lower intake and levels of vitamin A and zinc in plasma.

Metabolic/Laboratory Studies

A number of studies in animals using various types of diets, natural and synthetic carcinogens more or less confirm the epidemiological findings. Of these particular mention should be made of colon, breast, liver, lung, oral, oesophageal and stomach cancers.

The major enzymes involved in the metabolism of xenobiotic compounds are mixed function oxidases (MFO) and the conjugating enzymes which are abundant in liver. However extra hepatic tissues such as skin, lung, blood vessels and brain also possess the enzymatic activity. Endogenic substrate such as vitamin, lipids and hormones are also known to be metabolized by this group of enzymes. The substrates include a great variety of chemicals which are hydrophobic in nature such as fatty acids, steroids, vitamins, mycotoxins, alkaloids, pyrolysed product of carbohydrates and protein (charred food), nitrosamines, synthetic chemicals such as pesticides, drugs and other pollutants.

Conjugation of foreign chemicals is an important process in rendering the substrate more polar for excretion. Glucuronides and glutathione conjugates are the major conjugates in man and other animals.

Chemical carcinogens must be metabolised to their ultimate carcinogenic metabolite to form induced biochemical and subsequent pathological lesions. It is well established that the enzymes are influenced both by degree and number of nutrient imbalances.

A number of nutritional factors (macro and micro nutrients) are known to alter enzyme activities. Our laboratory studies on food deprived animals and humans indicate that undernutrition *per se* can result in processes which increase/decrease either bioactivation or inactivation and increase the formation of electrophilic substances which bind to macro molecules. Several studies in literature, including studies in humans indicate that induction of activation is invariably associated with higher cancer incidence e.g., lung and liver cancers. Proteins in the diet also induce the enzymes and lead to higher yield of DNA adducts of aflatoxins. In addition, micronutrients (vitamins and minerals) may inhibit formation of carcinogenic substances such as [illegible]. Vitamins A, E, C, zinc and selenium have been shown to inhibit formation of preneoplastic foci and cancer in animals and man.

Mutagens and carcinogens in foods

A variety of mutagenic/carcinogenic substances in foods have been identified. The first category includes naturally occurring substances such as bracken fern which is still frequently used in certain countries; the second category of substances are those produced during food storage, food processing or cooking which include mycotoxins, food additives, nitrosamines and pyrolysed products. The third category are derived from contamination from pesticides, fungicides, herbicides etc., which are used to protect plants.

Bracken fern occurs widely in nature and is consumed

CENTRESPREAD

Data presented in the centrespread pertain to the growth status (Gomez Classification, Weight-for-Age) of 1-5 year old children and the dietary status (in terms of Calorie-Protein Adequacy) of individuals belonging to the different socio economic groups in Bhopal (Madhya Pradesh). The urban data are compared with those obtained on rural population of Madhya Pradesh.

Growth Status of Preschool Children

About a third of the children in MIG and LIG had normal growth status. Among the children of IL and slum groups, nearly one-in-ten were found to have normal growth and were essentially similar to rural children.

While about 19% of slum children had severe growth retardation, the corresponding figures for LIG and IL were 6% and 1% respectively. In the rural areas, about 11% had severe weight deficit. With respect to moderate degree of growth retardation, while there were no differences between MIG (11%) and LIG (12%), the proportion was much higher in slum (30%) and IL (40%) children. In the rural areas, the percentage of moderately growth retarded children was comparable to the IL (40%).

About 50-60% of the urban groups were consuming adequate amounts of protein and calories in their diets. The percentage of rural individuals consuming adequate calorie and protein was similar to that observed in slum areas.

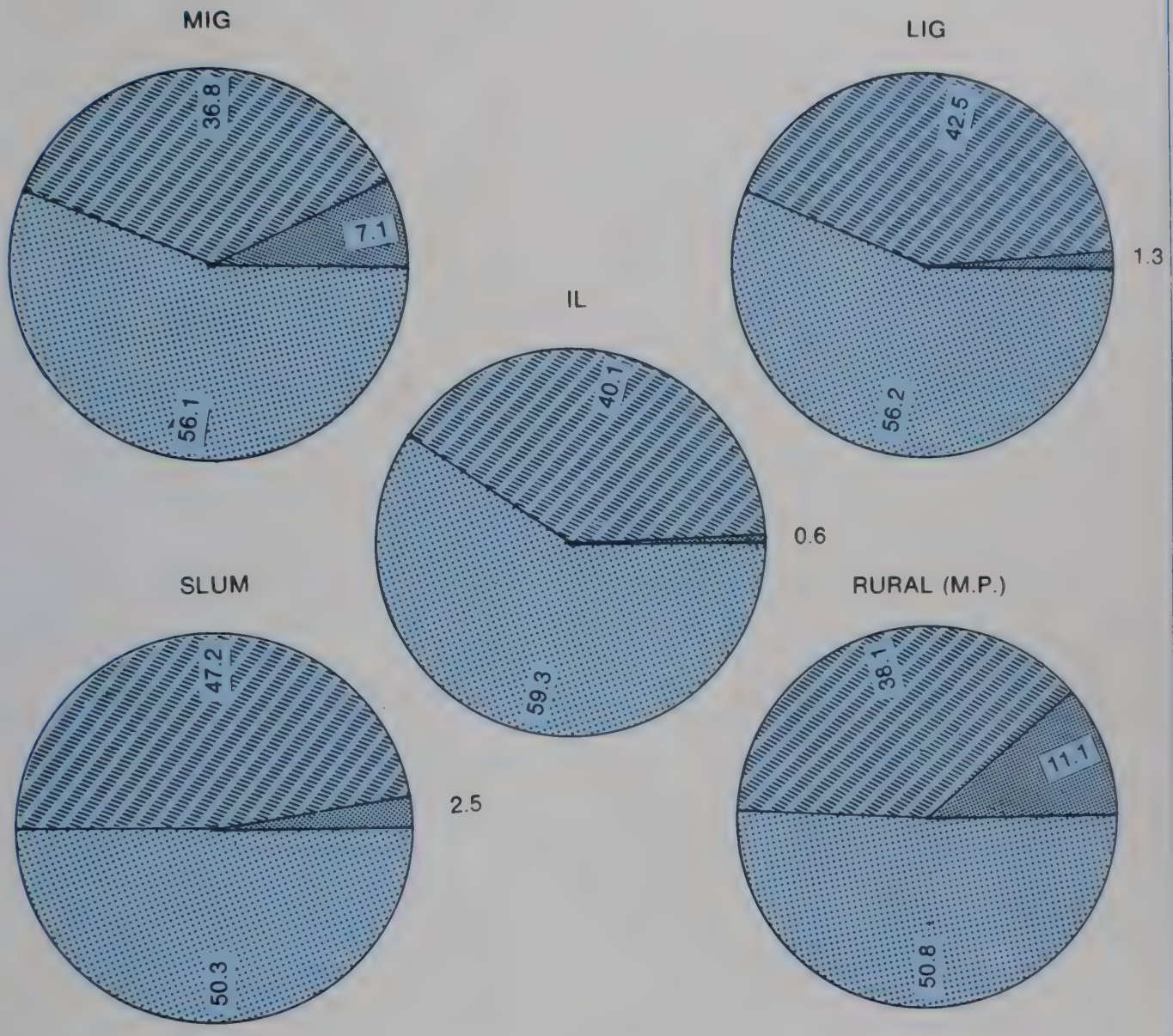
Editor's Note

We find that a minor error has crept in the depiction of data relating to 'Percentage Distribution of Children (1-5 years) in Trivandrum (Kerala) According to Grades of Malnutrition' on the Centrespread of NUTRITION NEWS - Nov. 1985 (Vol.6 No.6).

While the data presented and the graphic representation in the form of bar diagrams are correct, there is a mistake in markings on the scale of the diagram. Readers are therefore requested to note this. Inconvenience caused by this inadvertent error is regretted.

CALORIE PROTEIN INTAKE STATUS OF INDIVIDUALS (PERCENTAGE) FROM DIFFERENT SOCIO-ECONOMIC GROUPS IN BHOPAL (MADHYA PRADESH)

(Source: NNMB Surveys, 1975-80)



P: Protein C: Calories

+: Adequate —: Inadequate

P- C-

P+C-

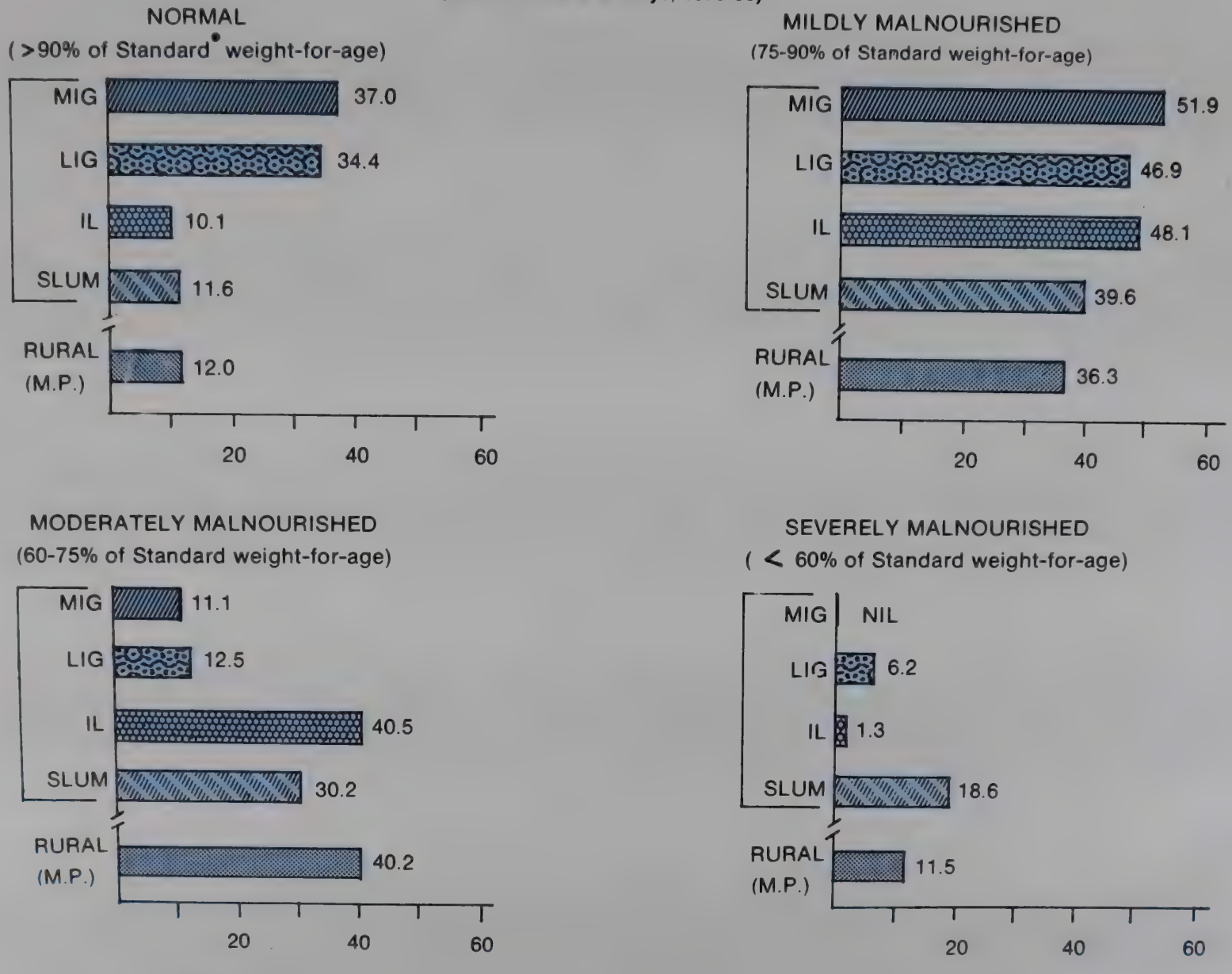
P+C+

MIG: Middle Income Group LIG: Low Income Group IL: Industrial Labourers

Number of Individuals Surveyed in High Income Group (HIG) was small for Analysis.

PERCENTAGE DISTRIBUTION OF CHILDREN (1-5 YRS) IN BHOPAL (MADHYA PRADESH) ACCORDING TO GRADES OF MALNUTRITION

(Source: NNMB Surveys, 1975-80)



Number of Children surveyed in High Income Group (HIG) was small for Analysis

•Standard: Well-to-do Indian Children.

MIG: Middle Income Group LIG: Low Income Group IL : Industrial Labourers

by humans in several parts of the world especially in Japan. In Japan a high risk of oesophageal carcinoma associated with daily intake of bracken fern has been identified. Similarly a direct association between coffee consumption and pancreatic cancer has been observed. Though many other plant substances such as methyl xanthines, hydrazines in mushroom, tannins, plant oestrogens such as zearalenone coumarins and pyrollizidine have been found to be carcinogenic in laboratory animals or as mutagenic in either bacterial or mammalian culture systems, the significance of these findings for human health is not known. Nitrates, nitrites and nitrosamines are carcinogenic and there is indirect though not conclusive evidence implicating these in oral, gastric and oesophageal cancer in humans.

The production of toxic compounds by living cells has long been recognised. Microbes and plant cells produce substances of carcinogenic activity. Primary hepatocellular carcinoma due to aflatoxin particularly in Africa is a well known clinical entity. Aflatoxin contaminants of ingested foodstuffs and liver cancer incidences have been related in many countries such as Thailand, China, Taiwan etc. Aflatoxin and oesophageal cancer has also been related in Linxian country in China. Other mycotoxins such as ochrotoxin, zearalenone, T toxin, patulins etc., have also been implicated in human cancer.

Considerable attention has recently been directed towards the presence of mutagenic activity in food. Mutagens in charred and smoked meat and fish (Benzo (a)pyrene derivative), foods cooked at high temperature (pyrolysed products) have been identified. However, the relevance of these to human health is yet to be determined.

A number of food additives (sweeteners) including packaging material (vinyl chloride) are now suspected to be mutagens/carcinogens, though epidemiological studies on exposure to vinyl chloride or to sweetener as food contaminant/additive causing cancers are hard to find. However, occupational exposure to vinyl chloride and cancer of liver, brain, respiratory tract and lymphatic system has been documented. A number of environmental contaminants such as organochlorine, pesticides, polychlorinated biphenyls and polycyclic aromatic hydrocarbons are known to produce cancer in animals. Epidemiological evidences do not suggest that these contribute significantly to the risk of human cancer.

Inhibitors of carcinogenesis

A substantial number of epidemiological surveys demonstrate an inverse relationship between consumption of vegetables and cancer, especially of gastro intestinal tract. Vegetables in addition to nutritive constituents have certain inhibitors such as phenols, indoles, aromatic isothiocyanates, flavones, protease inhibitors and plant sterol β-sitosterol. The inhibitory effects are mediated through changes in metabolism of carcinogens. Cruciferous vegetables are rich sources of these inhibitors and are known to protect against cancer at several sites. Thus carotene rich and cruciferous vegetables seem to decrease the risk of cancer in human subjects. Studies are in progress at our institute in relation to green leafy vegetables and metabolism of carcinogens in animals.

	CANCERS	DIETARY FACTORS	NUTRIENTS
1.	Oral cavity	Alcohol Tobacco snuff chewing Betel nut	Vitamin A, C, Zn
2.	Oesophagus	Low intake of meat, fish, fruits and vegetables corn as the staple alcohol, tobacco Bracken fern aflatoxins	Poor nutritional status Iron, Vitamin A, Riboflavin, Zn.
3.	Stomach	Nitrates, Nitrites and nitrosamines pickled vegetables salted substances fried foods smoked fish soya bean over nutrition	Vitamin C Vitamin E Protein Over nutrition Selenium
4.	Colon and Rectal	Low fibre refined carbohydrates	High fat and protein Vitamin A, C
5.	Larynx	Tobacco smoke	Vitamin A
6.	Lung	Cigarettes Low in green vegetables	Vitamin A, E
7.	Bladder	Industrial chemicals artificial sweetner coffee consumption	Vitamin A
8.	Prostate	Low in green and yellow vegetables	Higher vitamin A over nutrition high fat and protein
9.	Breast	Obesity Low in vegetables	β-carotene vitamin A high fat and protein
10.	Cervical cancer	Low in vegetables	Vitamin A, C. folic acid
11.	Pancreas	Tobacco smoke coffee	Over nutrition
12.	Liver	Aflatoxin	Poor nutrition

Dietary Policy

It is now recognised that nutrition has an important bearing on the determination of cancer risk in humans.

In order to minimize the risks of cancer in any population , perhaps it is better to adopt certain dietary recommendations, even though at present sufficient scientific evidence for such proposals are meagre and definite cause and effect relationship cannot be established. The most important recommendations would be to consume diets which would maintain weight for age. Both obesity and undernutrition need to be avoided. Fat as a nutrient should be limited with particular emphasis on proper ratio of unsaturated to saturated fatty acids. Excess of either of two can be harmful. It is wise to avoid highly salted, pickled, smoked, fried and charred food items. Moldy and damaged food substances have to be totally avoided. It is necessary to avoid refined foods and have a liberal supply of fresh vegetables and fruits, specially of cruciferous family and yellow vegetables and fruits. It is always better to avoid high supplements of any one single nutrient. Alcohol and tobacco have to be used in moderation.

The multifactorial etiology of cancer makes it difficult for one to comment on beneficial effects. It is also not possible to

offer absolute proof of benefit since we know about the existence of long latency period of cancers to develop. However, modification of diet may be sufficient to retard chain of causative events.

- Dr. Kamala Krishnaswamy.

WORKSHOPS

UNESCO sponsored Workshop on Teaching of Nutrition and Health Education at the Tertiary Level

A Workshop on the Teaching of Nutrition and Health Education at the Tertiary Level sponsored by UNESCO was held at the Institute between 4-8 November 1985.

Two participants including one each from Thailand and Philippines and eleven from India participated in the workshop.

The outline of curriculum guidelines for training in nutrition and health education provided by UNESCO was discussed at the workshop A comprehensive document on the guidelines to be followed by tertiary level institutes for training the trainers was finalised. The guidelines cover all aspects beginning from planning the curriculum for the programme (keeping the job responsibilities of health educators in view) upto the mechanics of programme evaluation.

In addition, the workshop drew up a plan for development of appropriate regional support materials, learning aids, teacher guides and also spelt out the logistics for designing a follow-up pilot project to test out the guidelines and support material.

First ICMR Workshop on Scientific Communication in Biomedicine

The First ICMR Workshop on Scientific Communication in Biomedicine was held at the Institute on 20-21 November 1985. Twenty scientists from five ICMR Institutes, viz., National Institute of Nutrition, Hyderabad, Tuberculosis Research Centre, Madras, Institute for Research in Medical Statistics, Madras, Vector Control Research Centre, Pondicherry, and Regional Medical Research Centre for Tribals, Jabalpur, participated in the workshop.

Lectures, panel discussion and demonstrations were held to expose the participants to latest information relating to data search and retrieval systems in biomedicine and reporting of biomedical research findings. Aspects relating to preparation of a scientific presentation for publication and the care that authors have to take in organising the scientific material and processing the same for publication in a form acceptable to journal editors were also discussed in the workshop.

RESEARCH NOTES

Effect of a meal on nutritional enzymology

Assessment of thiamine, riboflavin and pyridoxine status is routinely done by measuring the activities of erythrocyte enzymes transketolase (ETK), glutathione reductase (EGR) and aspartate aminotransferase (EaspAT) respectively and their *in vitro* activation with the respective coenzymes (activation coefficient-AC) These enzymatic tests are generally done in a fasting state. However, this requirement is often difficult to fulfil under field conditions. To assess the need for sampling blood under basal conditions, the effects of a meal on the activities of the three erythrocyte enzymes and their *in vitro* activation with coenzymes were tested.

Blood was drawn from ten adult men of low income group, before and 1, 2 and 3 hours after a breakfast consisting of chapatis, boiled egg, brinjal and potato curry and tea and enzyme assays were done. The meal provided 642 calories, 21.2 g proteins, 0.79 mg thiamine, 0.49 mg riboflavin and 0.68 mg pyridoxine.

Data show that a meal does not affect either the values for the erythrocyte enzyme activities or the activation coefficients. For a given subject the variations in values between the four time points (before and after meal) were comparable to the intraindividual variations in samples obtained on different days under fasting conditions.

Thus it can be concluded that for nutritional enzymology used for assessing B-complex status, basal conditions for the subject may not be mandatory.

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CURRENT TOPIC

DIET AND ATHEROSCLEROSIS

Atherosclerosis has reached epidemic proportions in many parts of the world. Today, it is common even in the developing countries including India. Affluence and other environmental factors including stress and strain of modern life seem to largely influence the increasing prevalence of atherosclerosis.

The thickening of the wall of the blood vessels is the main feature of atherosclerosis. Clinical manifestations of the disease vary, depending on the blood vessel which gets affected by atherosclerosis. If coronary arteries are affected and the flow of blood is blocked due to clot in these arteries the heart muscle suffers from lack of oxygen. This results in heart-attack (coronary heart disease). If such damage is severe, death may be sudden. When flow of blood to the brain is blocked due to atherosclerosis, it results in paralysis (stroke). Atherosclerotic damage in renal artery causes hypertension and peripheral vascular disease occurs if peripheral blood vessels develop atherosclerosis.

Several factors are known to interact and result in atherosclerosis. In the epidemiological triangle, host factors, environmental factors and the agent namely the lipid profile and blood clotting system (thrombosis) play a significant role in the atherosclerotic process. Altered metabolism of lipids (fatty material) and lipoproteins result in increased levels of lipids, mainly cholesterol and triglycerides in the blood which accumulate and thicken the wall of the blood vessels. This abnormality plays a critical and decisive though not an exclusive role in the development of atherosclerosis. Consequent to and concomitant with the injury caused to the blood vessel by the deposition of excess of lipids, platelets (a type of cells in blood) and blood clotting system contribute to the formation of blood clot (arterial thrombus).

All these processes may be active for decades in individuals without any clinical manifestations and are identified as disease due to block in the arteries. Since the disease manifests at a time when it is fatal (and probably irreversible), scientists have sought to detect non-invasive ways to detect the disease at an early stage. Alongside attempts have been made to define living habits particularly dietary practices that might be associated with an increased risk. As a result today we have a long list of factors identified as risk factors for atherosclerosis, some of them, controllable, and others non-controllable.

Non-controllable factors :

(which are beyond the control of the individual)

- age: risk increases with increasing age
- sex: risk is greater for men than for premenopause women.
- Family or genetic history: risk is greater in people where there is a family history of atherosclerosis in early age.

Controllable factors :

(which can be controlled at least partly).

- Cigarette smoking: smokers suffer from severe atherosclerosis.
- Those who discontinue smoking have a lower risk.
- With passage of time an ex-smoker's chance of getting heart attack equals that of non-smoker.
- High Blood pressure: increases the risk, keeping BP under control either by drugs or sodium-restricted diet decreases the risk of atheros.
- Exercise: sedentary (non-active) life style increases the risk as comparable to life style which provides regular exercise at work or play.
- Stress: may play a role in atheros.
- Diet: This aspect is discussed below in detail.

Diet

The type of diet has an important role in the development and progression of atherosclerosis. Alterations in blood lipids and subsequent reactions of thrombosis are in fact the end results of dietary habits over decades. Often dietary practices directly result in increased levels of lipids in blood or trigger an underlying genetic tendency to atherosclerosis. In the rest of the discussion the role of dietary factors in the pathogenesis of atherosclerosis has been highlighted. The critical dietary factors are cholesterol, fat and total calories.

Cholesterol :

Cholesterol in blood is derived from two sources namely, diet and endogenous synthesis (mainly liver

and gut). Only 25-50% of the ingested cholesterol (200-1000 mg/day) is absorbed. However, if dietary intakes of cholesterol are markedly increased, the absorption is also significantly elevated. Dietary cholesterol inhibits the endogenous synthesis of cholesterol. This feedback inhibition shows wide individual variation. Cholesterol is excreted into the bile as cholesterol and bile acids. These are eliminated through faeces. The excretion of cholesterol and bile acids are known to increase with rise in dietary cholesterol.

The extent of effect of dietary cholesterol on blood cholesterol in human beings varies from individual to individual. This responsiveness depends on the extent to which dietary cholesterol interacts with the cholesterol homeostasis (absorption, feedback inhibition and excretion) in each individual. The effect of dietary cholesterol on blood cholesterol levels is also influenced by the nutrient composition of diet. In addition, the baseline level of dietary cholesterol from which observations are made is also important. Because of these variations, there has been a confusion and heated debate as to whether dietary cholesterol will influence the levels of blood cholesterol. The widely accepted view today is that on cholesterol intakes upto 500mg/day, dietary cholesterol may be less important as compared to other dietary variables in influencing blood cholesterol levels in 80% of the people. The rest of the people may be high responders. There is no easy way of predicting high responders.

Laymen and the media alike seem to be confused over the terms "dietary cholesterol" and "blood cholesterol". Dietary cholesterol is of less importance as compared to total calories and fat in increasing blood cholesterol level. However, blood cholesterol is an important risk factor for atherosclerosis and persons with high levels of cholesterol in blood have a greater chance of suffering a heart attack than those with lower levels. Cholesterol is transported in blood as lipid protein complexes called lipoproteins. Lipoproteins have been named according to their density, each having a distinct physiological role. The low density lipoprotein (LDL) carries cholesterol from the liver to all the organs of the body including blood vessels and heart. Increase in LDL cholesterol increases the risk of atherosclerosis. The high density lipoprotein (HDL) helps to mobilize the cholesterol depots from the tissues. In other words HDL acts as a scavenger and prevents the accumulation of cholesterol in the blood vessels and heart. Increase in HDL cholesterol is associated with a decrease in the risk of atherosclerosis. In recent years, it is therefore emphasized that in addition to total cholesterol in blood, its distribution in LDL and HDL is also important in predicting the risk of atherosclerosis in an individual or a population.

That elevated blood cholesterol is a major risk factor for atherosclerosis is certain. The lingering doubt is whether lowering blood cholesterol will lower the risk of atherosclerosis. This is all the more difficult in a human population where elevated cholesterol levels have already resulted in sufficient irreversible damage. This should not be interpreted to mean that high levels of blood cholesterol are not deleterious to health. Nor should one entertain doubts regarding benefits of lowering blood cholesterol levels in patients with high levels of lipids in blood. More recently,it has been demonstrated that reducing blood cholesterol levels by the drug cholestyramine reduces the risk of coronary heart disease. It is therefore suggested that doctors should emphasize to patients with atherosclerosis the desirability of switching over to diets which will reduce blood cholesterol. People of the high income groups should be advised to keep a check on their dietary habits so as to prevent high blood levels of triglycerides and cholesterol.

Fat

The amount and kind of fat in the diet affects the levels of lipids in blood as well as thrombosis. Fats may be divided into three major classes identified by saturation and unsaturation of their fatty acids.

Saturated fatty acids :

All animal fats (butter, ghee) are highly saturated except for those which occur in fish and shell fish. Coconut oil and hydrogenated vegetable oils are also rich in saturated fatty acids.

CENTRESPREAD

Data presented in the centrespread pertain to the growth status (Gomez classification, weight-for-age) of 1-5 year old children and their dietary status (in terms of calorie-protein adequacy) of individuals belonging to the different socio-economic groups in Nagpur (Maharashtra). The urban data are compared with those obtained on rural population of Maharashtra.

Growth status or urban preschool children :

The percentage of children having 'normal' body weight was highest in MIG (45.1) followed by IL (10.3), LIG (5.3) with lowest being in slums (3.5). The corresponding figure in rural Maharashtra was 9.3% which was close to that seen in IL group.

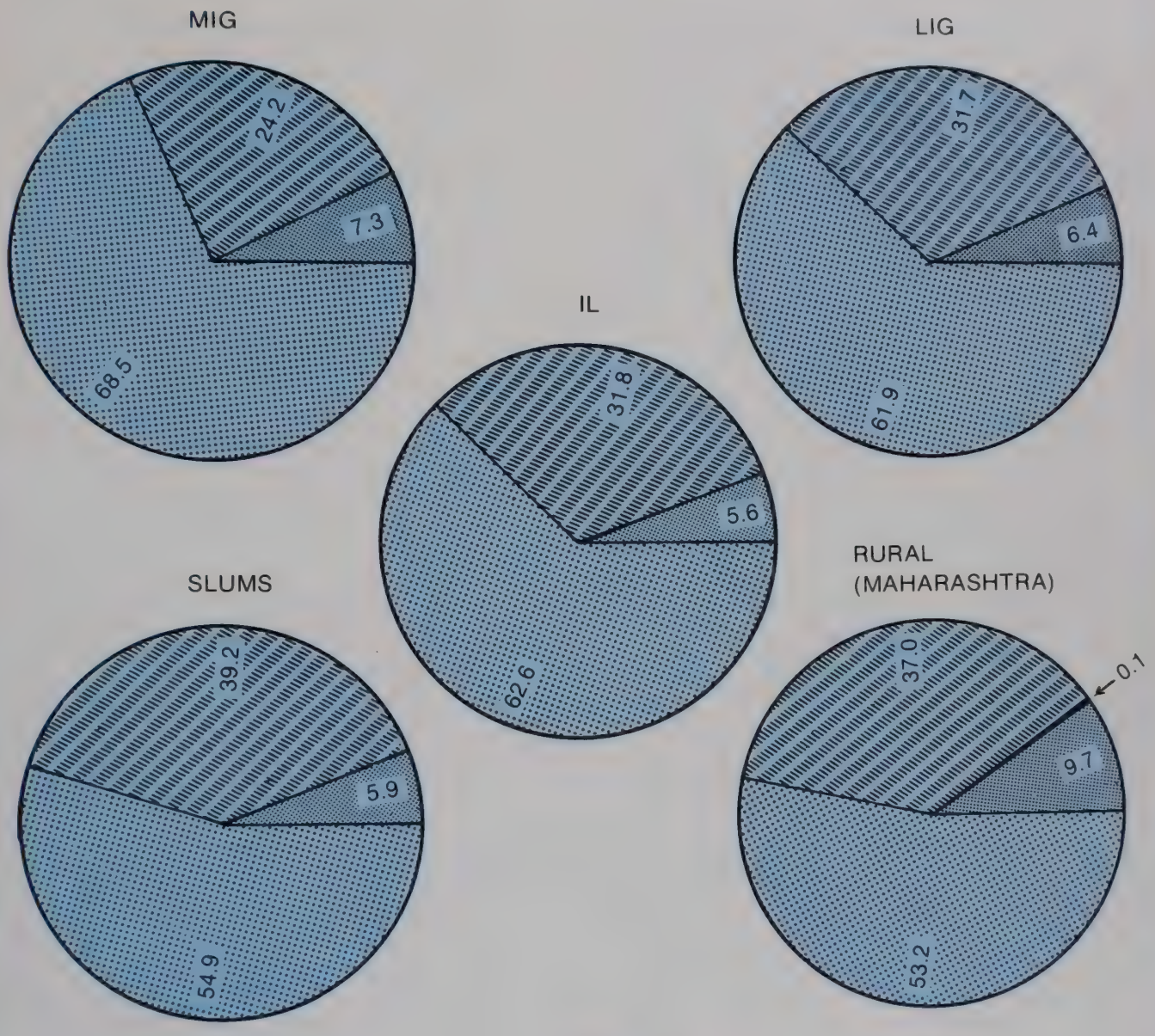
The picture of prevalence of severely malnourished children was reflecting the same status of different socioeconomic groups i.e. the prevalence of severe degree of malnutrition was found to be highest among slum children (15.7) followed by IL (10.3) and LIG (5.3). In MIG none was severely malnourished.

In general, the growth status of IL and rural groups were found to be comparable.

The percentage of calorie inadequacy in the urban subjects ranged from 31.5 in MIG to 45.1 in slums. In LIG and IL the figures were around 38% while in rural areas it was 46.7%.

CALORIE PROTEIN INTAKE STATUS OF INDIVIDUALS (PERCENTAGE) FROM DIFFERENT SOCIO-ECONOMIC GROUPS IN NAGPUR (MAHARASHTRA)

(Source: NNMB Surveys, 1975-80)

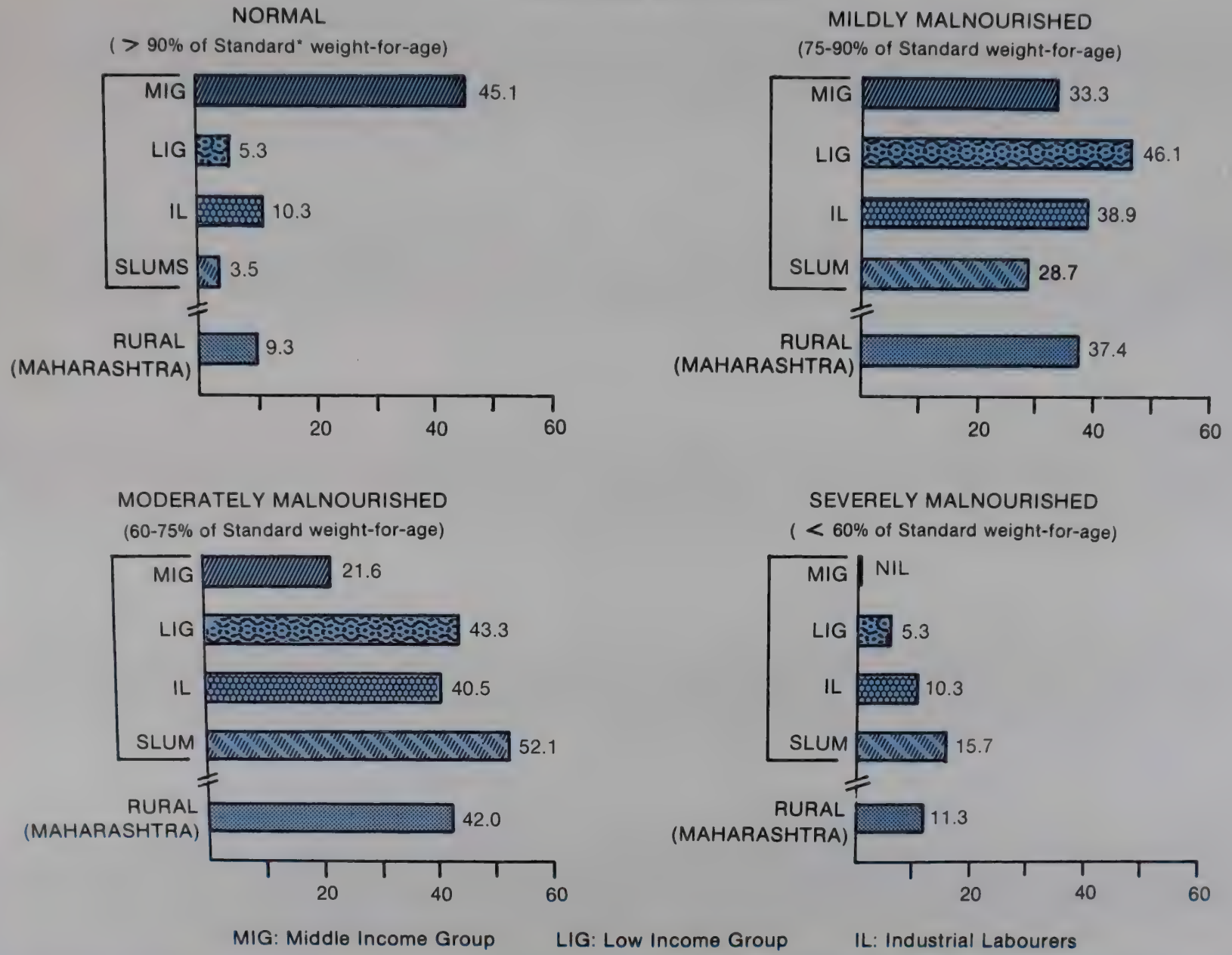


MIG: Middle Income Group LIG: Low Income Group IL: Industrial Labourers

Number of Individuals Surveyed in High Income Group (HIG) was small for Analysis

PERCENTAGE DISTRIBUTION OF CHILDREN (1-5 YRS) IN NAGPUR (MAHARASHTRA) ACCORDING TO GRADES OF MALNUTRITION

(Source: NNMB Surveys, 1975-80)



Number of Individuals Surveyed in High Income Group (HIG) was small for Analysis

*Standard: Well-to-do Indian Children

MIG: Middle Income Group LIG: Low Income Group IL: Industrial Labourers

Monounsaturated fatty acids

These are present in all animal and vegetable fats.

Essential Fatty Acids (EFA)

These are not synthesized in the body unlike saturated and monosaturated fatty acids. They have to be obtained through diet. There are two types of EFA namely linoleic (omega 6) and linolenic (omega 3) acids. The ingested EFA are converted to fatty acids of longer chain length and with more number of double bonds. The EFA and their longer chain derivatives are popularly referred to as polyunsaturated fatty acids (PUFA).

Effects of dietary fat on blood cholesterol

High fat diets as well as saturated fats increase the level of blood cholesterol, though monounsaturated fats have no such effect. Linoleic acid and its PUFA (omega 6) increase excretion of cholesterol and bile acids into the faeces, resulting in a negative cholesterol balance. Reduction in blood cholesterol is more easily achieved by reducing saturated fat than by increasing PUFA (omega 6). During the last 3-4 years several studies have shown that omega 3 PUFA present in fish and fish oil lowers the levels of cholesterol and also triglycerides in blood. More recently, it has been observed that on gram for gram basis, the omega 3 PUFA of fish oil has a greater cholesterol lowering effect than the omega 6 PUFA.

In India, dietary fat consumption is income related. In a recent study conducted at NIN among apparently normal men,blood cholesterol levels were found to be high in the relatively affluent as compared to those in men of low income group. The levels of HDL cholesterol were however similar in all the socio-economic groups investigated. Although the intakes of visible fat (mainly groundnut oil) were low in subjects of the low income group, their essential fatty acid (EFA) nutritional status as indicated by plasma total fatty acid profile was satisfactory. However these studies do not reflect the physiological functioning of platelets in relation to diet intake in prevention of atherosclerosis. Studies are in progress to determine the effect of Indian diets on platelet function.

Rats fed palmolein with poor EFA content exhibited marginally adequate EFA nutritional status as compared to rats fed groundnut oil or corn oil as the sole source of dietary fat.The magnitude of changes with respect to EFA nutritional status in rats fed palmolein were mild as compared to the changes observed in rats fed hydrogenated coconut oil or coconut oil. A major part of linoleic acid in Indian diets is obtained from invisible fat in cereals and pulses. Therefore, the effects of replacing groundnut oil with palmolein may be made up by the linoleic acid present in cereals and pulses.

Effects of dietary fat on thrombosis

In addition to its effects on blood lipids and lipoproteins, dietary fat has a direct effect on platelets and coagulation system. Saturated fats make the platelets more sticky (promote platelet aggregation). Also saturated fats activate the coagulation system. Both these processes favour thrombus formation. In platelets and blood vessels the omega 6 PUFA are converted to an important class of biological regulators known as prostaglandins (eicosanoids).

The prostaglandins have an important role in vascular homeostasis. The net effects of the prostaglandins that are formed from omega 6 PUFA are antithrombotic. More recent studies have shown that omega 3 PUFA present in marine oils have a greater antithrombotic effect as compared to the omega 6 PUFA. In one of our studies growing rats were fed diets containing different levels of protein and EFA. The data obtained on plasma total fatty acid composition suggested that the requirement of EFA may be high when diets are moderately low in protein. These studies also indicated that apart from dietary fat, the level of protein in the diet affects the metabolism of prostaglandins.

Studies on the role of dietary factors on the metabolism of EFA and prostaglandins may help us understand the effects of diet on thrombosis. This area needs to be explored specially in relation to the dietary pattern and habits of the Indian population.

A proper balance of the different fatty acids plays a significant role in maintaining the blood lipid levels and thrombotic tendency. It is therefore suggested to have a variety in the kinds of fats consumed instead of consuming one edible oil as the chief source of visible fat. Thus it is important to be conscious of the quantity as well as quality of fat consumed.

Calories

Excessive intake of calories from any source namely, carbohydrates, proteins, fat or alcohol increases the levels of triglyceride and cholesterol in blood.

Substances whose effects are less significant as compared to those already discussed are 1) Carbohydrate, dietary fibre and protein.

Carbohydrates : refined foods and fibre

Large quantities of sucrose increase triglyceride levels. A decrease in the consumption of sucrose (sugar) is therefore recommended for people in the high risk group. Dietary fibre found in unprocessed cereals, legumes, vegetables and fruits, contributes bulk to the diet and therefore helps in keeping calorie intake low. The effect of dietary fibre depends on the type. Wheat fibre does not decrease blood cholesterol but viscous types like pectins and guar gums in large doses lower plasma total cholesterol and LDL cholesterol levels. Refined flour, sugar and in general refined foods are known to increase the levels of cholesterol and triglycerides in blood.

Protein

Vegetable proteins have a cholesterol lowering effect. Therefore, consumption of more plant foods may be beneficial to patients with increased lipid levels in blood.

Drinking water

CHD mortality has been found to be lower in areas where drinking water is hard than in soft water areas. The minerals and trace elements present in hard water play a protective role.

On the basis of firmly established scientific information it is concluded that among the multiple risk factors, *diet is of key importance* in the etiology of atherosclerosis. Regardless of the degree to which non-controllable risk factors contribute to increased lipid levels in blood, dietary treatment will always result in an improvement. The following dietary guidelines are recommended for patients with atherosclerosis and also for people having one or more risk factors :

1. Energy intake should be in balance with energy expended.
2. Intake of total fat and saturated fat should be moderate. This is preferably achieved by avoiding ghee, butter, cream and egg yolk. Since cereals and pulses alone contain half of the total fat intake in Indian diets, the intakes of visible fat may be maintained around 10-15% of the energy (20-30 gms per person per day).
3. The visible fat should be obtained from vegetable oils. Instead of using one type of oil as the sole source of visible fat it is desirable to have a variety in the type of vegetable oils consumed. This will ensure a balance in the intakes of various fatty acids.
4. Vegetable oils are rich in linoleic acid (omega 6 type). PUFA of omega 3 type should also be consumed. These are obtained from green leafy vegetables. Desirable amounts of omega 3 PUFA can be obtained by consuming sea foods once or twice in a week in place of other non-vegetarian foods.
5. Intake of empty calories (sugar) should be reduced. Foods that contain complex carbohydrates and fibre (whole grain products, pulses, vegetables and fruits) should be preferred.
6. High sodium and alcohol intake should be avoided.
7. Food should not be consumed as one or two meals. One meal per day increases the blood cholesterol and triglyceride levels significantly, as compared to the levels for the same amount of food consumed in three meals.
8. Since risk factors are additive,atleast those factors which can be manipulated either by diet or change in habits should be encouraged.

Dr.Ghafoorunissa

RESEARCH NOTES

VITAMINS B2, B6 AND LACTATION

Riboflavin and vitamin B6 status of mothers from low income groups were assessed by erythrocytes glutathione reductase and erythrocyte aspartate-aminotransferase activation tests respectively, at different stages of lactation. Levels of these vitamins in milk were also measured. Majority of the women had biochemical evidence of vitamins B2 and/or B6 deficiency. There was a unexpected reduction in erythrocyte glutathione reductase activation from 6 to 30 days post partum. Levels of vitamin B2 in milk were similar but those of vitamin B6 lower than the values reported from developed countries. Clearcut correlations between the enzymatic indices of vitamin status evaluation and milk levels of the corresponding vitamins were not apparent.

TRAINING PROGRAMMES

ORIENTATION COURSE FOR MIDDLE LEVEL PERSONNEL

A 3-week orientation course sponsored by WHO and ICMR for middle level personnel from primary health centres and those who are connected with nutrition programmes in various parts of India was held at NIN between 3-24 March 1986. This programme was conducted to provide a broad understanding of the prevailing problems in the area of health and nutrition and strategies adopted to combat them. There were 14 participants from different states of India. These participants were trainees of local health functionaries and personnel in supervisory cadre of primary health care service programme.

The Nineteenth M.Sc.(Applied Nutrition) Course and the Ninth Annual Certificate Course in Human Nutrition for teachers from Agricultural Universities are scheduled to commence from 1st June 1986.

Nine senior medical officers/teachers in medical colleges from the states of Andhra Pradesh, Bihar, Kerala, Madhya Pradesh, Orissa and Rajasthan are expected to participate.

Twelve faculty members belonging to the disciplines of Home Science/Agriculture and Food Technology/Veterinary Sciences from different Agricultural Universities in the country will participate in the Certificate Course in Human Nutrition.

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CURRENT TOPIC

NUTRITION AND HEALTH CONSEQUENCES OF CONCEPTION DURING LACTATION

Community based studies have shown that lactation prolongs postpartum amenorrhea and provides protection against pregnancy in the first few months of lactation. However, with increasing duration of lactation the contraceptive effect of lactation wanes. Among traditional Indian low income population groups, prolonged lactation for 20-30 months is common; contraceptive use is not widespread in these women. Under these circumstances, about one-third of all pregnancies occur in lactating women. Some women stop lactating as soon as they come to know that they are pregnant. This tradition might have been evolved to protect the woman from being subjected to dual stress of pregnancy and lactation. However, a substantial proportion of women continue to breastfeed their infants and face the concurrent dual stress of pregnancy and lactation.

In spite of the fact that conception during lactation and continued lactation during pregnancy are common, there have so far been no detailed investigations on the health and nutritional consequences of the dual stress. Nor is there any information available regarding its effect on the breastfed child and foetus in utero. Results of some of the investigations undertaken to explore these problems are discussed here.

Conception during lactation

Analyses of data on duration of lactation at the time of conception in 764 women showed that only 15.8% of all women conceived during the first year of lactation. Majority of conceptions occurred in the second (33.6%) and third year (51.6%) of lactation. In the urban, hospital-attending population under investigation, prolonged unsupplemented lactation upto 9-10 months was common. The average duration of lactational amenorrhea was 10-11 months. Conceptions rarely occurred during lactational amenorrhea and because of this, the proportion of women conceiving in the first year of lactation was quite low. However, with waning lactation during the second and third year, more pregnancies occurred. Initiation of contraception soon after return of menstruation would have prevented these pregnancies.

Lactating women *at risk* of conceiving

If lactating women at higher risk of conception could readily be identified by some simple parameters, appropriate contraceptive care could be provided to this group. A wide variety of factors - socio-economic, educational and working status of women, infant feeding practices including time of introduction of supplements to breastfed infants influence infant feeding and fertility. Data on these aspects were compared between women who conceived during lactation (study group) and those who did not conceive during lactation (control group). Among the group of women who conceived in the first year of lactation, there was a preponderance of working women who introduced supplements prior to 6 months. There were no significant differences in any other parameters investigated between the control and study group women.

It is well established that introduction of supplements to breastfed infants results in fall in plasma prolactin levels of mothers and consequent rapid return of menstruation and fertility. If women could be taught to seek contraceptive care soon after return of menstruation, these pregnancies might be prevented. Nutrition education regarding appropriate time of introduction of supplements to breastfed infants should be coupled with messages on need to initiate contraception following such supplementation.

Dietary intake of pregnant and lactating women

Studies undertaken at the National Institute of Nutrition indicate that women from low-income group subsist on diets inadequate to meet the nutritional needs even in the non-pregnant state. There was no significant increase in dietary intake of women during pregnancy and lactation. Diet surveys undertaken among women who had conceived during lactation

indicate that there is no increment in their dietary intake either. The average dietary intake was below requirement and the diet was deficient with respect to all nutrients including vitamins and minerals.

Nutritional status of pregnant and lactating women

Dual stress of pregnancy and lactation would certainly widen the already yawning nutritional gap between actual dietary intake and nutrient requirements in women from urban low-income group.

The impact of low dietary intake on maternal nutritional status might vary depending upon the duration of lactation and period of pregnancy. An attempt was made to assess the impact of these factors on nutritional status of women who conceived during lactation (764) by comparing them with a group of pregnant women from similar income groups who had not conceived during lactation (3457).

Irrespective of the duration of lactation at the time of conception, women belonging to the study group had lower body weight in all the three trimesters of pregnancy. The differences were more marked in the third trimester especially in the small group of women who had conceived during the first 6 months of lactation (Table 1). There were no significant differences in the haemoglobin levels or prevalence of deficiency signs between the study and control groups.

TABLE - 1

ANTHROPOMETRIC INDICES OF NUTRITIONAL STATUS IN PREGNANT WOMEN WHO ARE ALSO LACTATING (Third Trimester)

Groups	Height (Cms.)	Weight (Kgs.)
P_3	150.8 ± 4.27 (152)	49.5 ± 5.12 (152)
L_1P_3	149.2 ± 6.13 (9)	41.9 ± 3.20 (8)
L_2P_3	149.9 ± 4.49 (66)	47.1 ± 6.19*** (66)
L_3P_3	148.8 ± 5.32 (31)	46.9 ± 7.27** (32)

*** P<0.001 ** P<0.01

Since the study and control groups of women came from families with similar socio-economic status and had similar dietary intake, it is likely that the lower body weight in the study group might be attributable to dual stress of pregnancy and concurrent lactation. Women who had conceived in the first six months of lactation fared worst because (a) they did not have any time to recover from the stress of previous pregnancy, (b) the volume of milk secretion and the nutrient loss in milk are greater in the first year of lactation, and (c) substantial number of these women were working outside home and therefore had to face the energy needs for work outside home.

It is obvious that conception during lactation does have an adverse effect on maternal nutritional status during pregnancy. Ensuring contraceptive care to lactating women would therefore constitute a non-nutritional intervention in reducing the magnitude of the problem of maternal undernutrition in pregnancy.

Morbidity in pregnant and lactating women

Ample data exist to indicate that pregnancy is associated with immunosupression and that the prevalence of morbidity due to infection is, to some extent, higher in pregnancy. It is well documented that undernutrition is associated with increased susceptibility to infection. Since pregnant and concurrently lactating women are likely to be more undernourished than their counterparts who did not conceive during lactation, one might expect a higher prevalence of morbidity due to infection in the study group. Prevalence of morbidity due to infection in the study and control groups however failed to show any difference between the two groups. It is possible that under the existing conditions of poor environmental sanitation and immunosupression due to pregnancy, the impact of greater degree of undernutrition on morbidity rates was not obvious.

Reproductive performance

Comparison of past reproductive performance of

CENTRESPREAD

Data presented in the Centrespread pertain to the growth status (Gomez classification, weight-for-age) of 1-5 year old children and their dietary status (in terms of calorie-protein adequacy) of individuals belonging to the different socio-economic groups in Madras (Tamil Nadu). The urban data are compared with those obtained on rural population of Tamil Nadu.

Growth status of urban preschool children

The percentage prevalence of severe degree of malnutrition was found to be about 6% in slums and Low Income Group compared to Middle Income Group (4.8%) and Industrial Labourers Group (1.8%). This figure (6%) was comparable to that seen in rural children.

The percentage of individuals consuming inadequate amounts of proteins and calories ranged from 3.0 in IL to 18.6 in slums. In MIG and LIG the figures were 4.4% and 5.0% respectively while in rural areas it was 11.2%.

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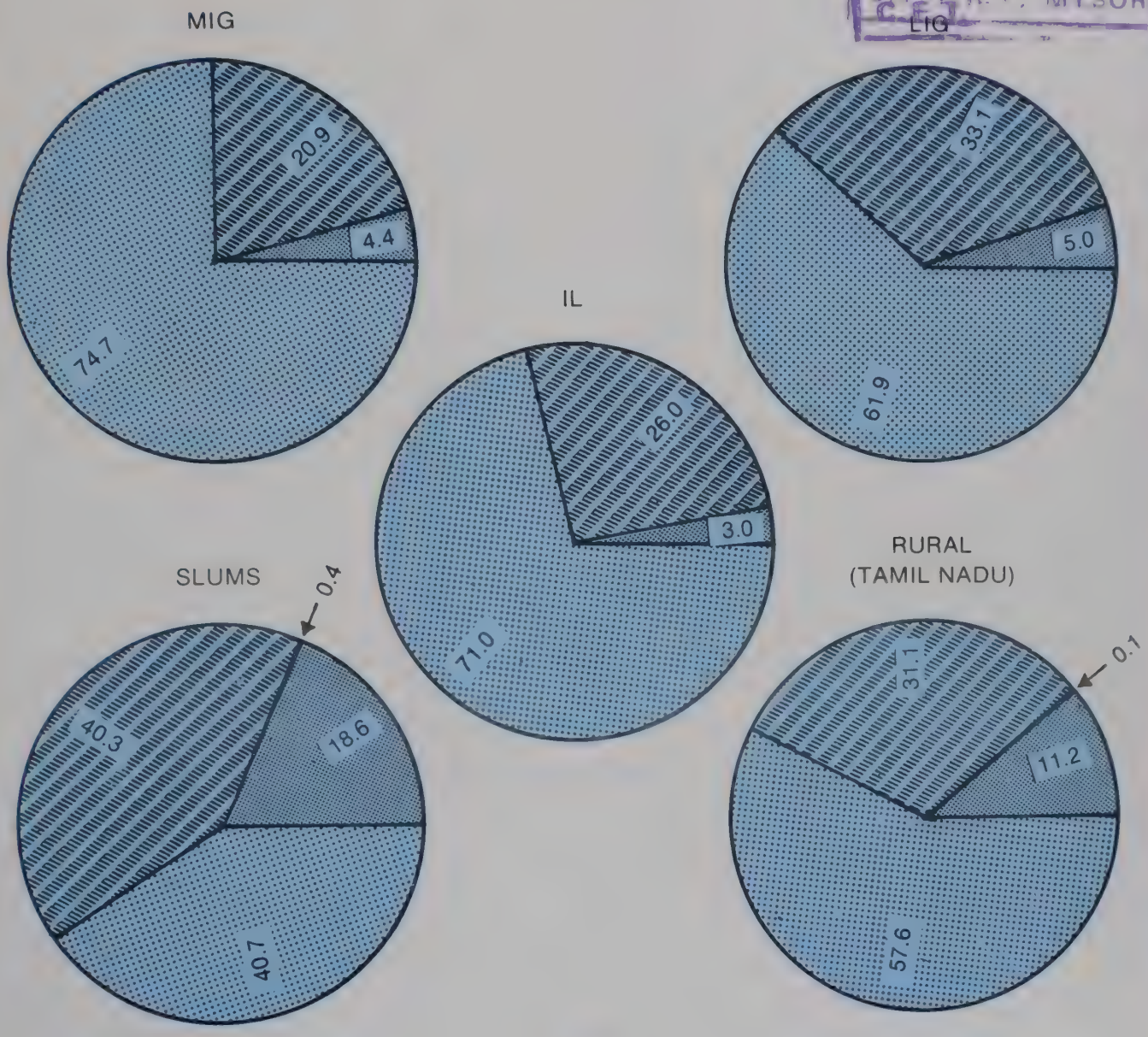
CALORIE PROTEIN INTAKE STATUS OF INDIVIDUALS (PERCENTAGE) FROM DIFFERENT SOCIO-ECONOMIC GROUPS IN MADRAS (TAMIL NADU)

(Source: NNMB Surveys, 1975-80)



P : Protein C : Calories

+ : Adequate - : Inadequate

P-C-

P+C-

P-C+

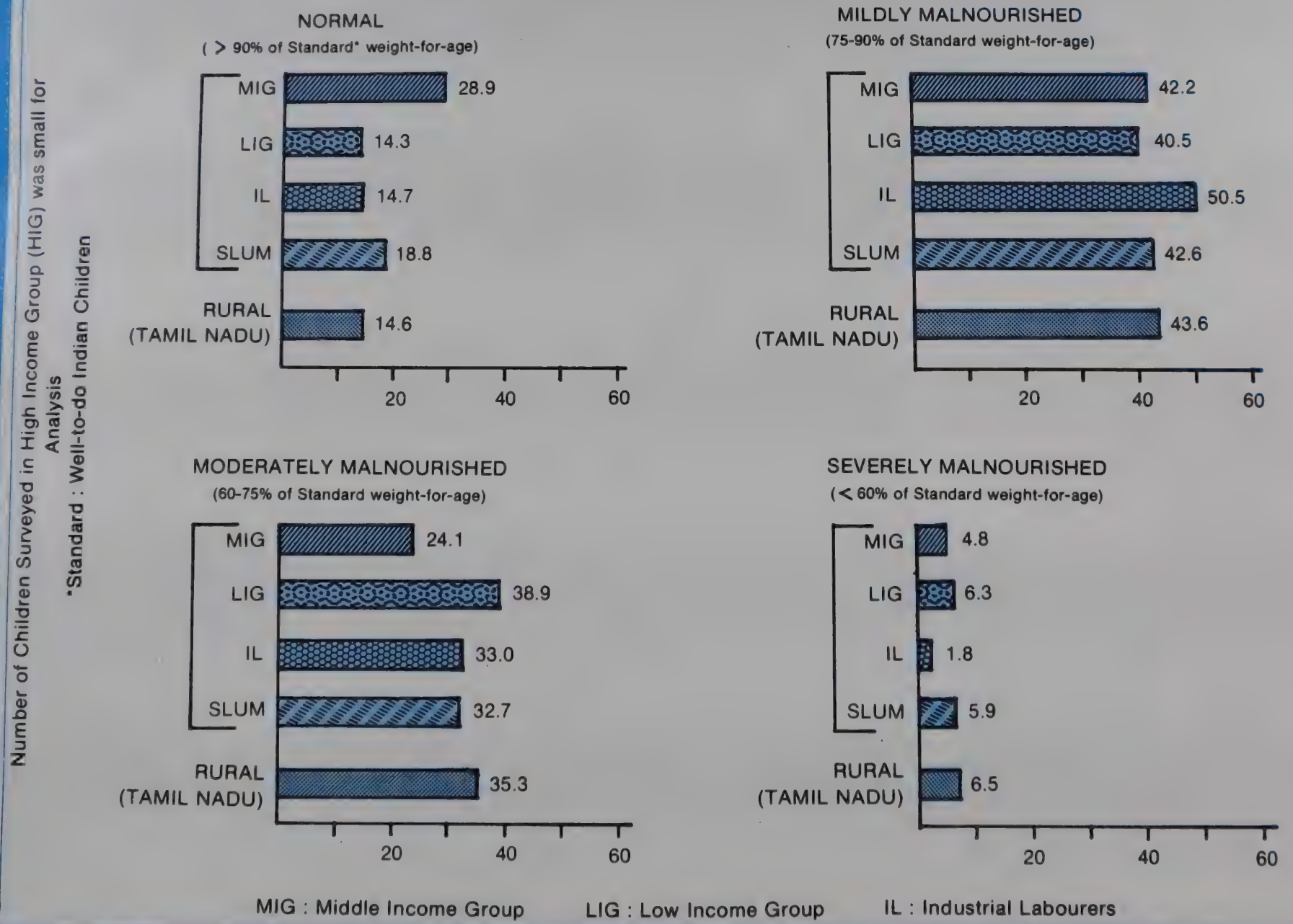
P+C+

MIG : Middle Income Group LIG : Low Income Group IL : Industrial Labourers

Number of Individuals Surveyed in High Income Group (HIG) was small for Analysis

PERCENTAGE DISTRIBUTION OF CHILDREN (1-5 YRS) IN MADRAS (TAMIL NADU) ACCORDING TO GRADES OF MALNUTRITION

(Source : NNMB Surveys, 1975-80)



study and control groups indicated that there were no differences between the two groups. Nor was there any difference in the course and outcome of pregnancy. However, birth weight was significantly lower both in the study and control group women in whom interpregnancy interval was less than one year (Table 2).

TABLE - 2

EFFECT OF CONCEPTION DURING LACTATION ON BIRTH WEIGHT OF INFANTS

	Birth Weight (Kg.) Interpregnancy interval (months)		
	⩽12	13-24	>25
1. Pregnant	2.62 ± 0.385 (603)	2.82 ± 0.421 (1371)	2.80 ± 0.439 (1950)
2. Pregnant women who were lactating	2.58 ± 0.398 (93)	2.80 ± 0.413 (217)	2.78 ± 0.429 (310)

Figures in parentheses indicate number of women.

The adverse effect of short interpregnancy interval on birth weight and perinatal mortality rate is well documented. The fact that conception within one year after last delivery has an adverse effect not only on maternal nutritional status but also on birth weight and infant survival reinforces the need for providing contraceptive care to all women to prevent too early advent of next pregnancy.

Infant growth and survival

A comparison of health and nutritional status of infants belonging to the study and control groups revealed that except for infants whose mothers had conceived during the first six months of lactation, there were no differences in the growth or survival of infants and children belonging to the study and control groups.

Studies from NIN and elsewhere have shown that estrogens secreted in breast milk of oral contraceptive users exert biological effects on breastfed infants. During pregnancy large amounts of estrogen are secreted by the placenta and circulate in the maternal blood. During the present survey, specific attempts were made to look for such side effects but none of the infants and children examined showed any abnormality. So far, in the world literature, there has not been any reported cases of side effects due to steroid ingestion through breast milk in pregnant, lactating women.

The reason for the absence of these side effects inspite of the fact that much greater amounts of steroids are circulating in blood is at the moment not clear and needs further exploration.

Summary and conclusions

Studies undertaken in the urban low-income group women attending nutrition clinics in Government Maternity Hospital and Niloufer Hospital for Women and Children, Hyderabad, indicate that about one-third of all conceptions occur in lactating women. Conceptions during the first year of lactation are rare and tend to occur in working women and those who introduce supplements to breastfed infants early in the third or fourth month of lactation. Dietary intake of pregnant and lactating women is inadequate with respect to all nutrients. Pregnant and lactating women weigh less than those who conceived after cessation of lactation in all trimesters of pregnancy. The adverse effect on maternal body weight and weight gain in pregnancy was most marked in women who conceived during the first six months of lactation. It is obvious that concurrent dual stress of pregnancy and lactation has adverse effect on maternal nutrition.

Birth weight of infants born to women who conceived during the first 6 months of lactation was significantly lower. There is thus an urgent need to initiate contraceptive care to lactating women soon after introduction of supplements to breastfed infants or return of menstruation. Such a step would prevent deterioration in maternal nutrition in pregnancy and birth weight of offspring.

- Dr. Prema Ramachandran

RESEARCH NOTES

GLYCAEMIC RESPONSE OF SOME INDIAN PREPARATIONS

Diabetes mellitus is not a single entity, but a heterogenous disorder characterized by hyperglycaemia. The 'hyperglycaemic' state is often accompanied by impaired lipid and protein metabolism. Most complications of diabetes have been attributed to hyperglycaemia. A better control of blood glucose has invariably been associated with fewer complications particularly the macro and micro vascular complications. Though insulin and other drugs have been used for controlling blood glucose levels, diet *per se* has been one of the major modes of therapy.

Recent studies clearly demonstrate that different carbohydrate sources raise the blood glucose to variable extent and simple carbohydrate exchanges based on chemical analysis are not sufficient to predict the physiological response. It is therefore recommended that therapeutic dietary suggestions be based on what is known as glycaemic index of a particular food item or preparation. Glycaemic index is based on the blood glucose response to a food in comparison with response to an equivalent amount of glucose.

We have no data on glycaemic index of commonly used food items in our country, where carbohydrates from different cereals are used. Therefore common preparations such as idli, upma, ragi roti and bread were tested for glycaemic response as compared to a 50g. glucose load.

A total of 13 subjects participated in the study. Glucose tolerance test was done on each individual with 50 g. glucose load and compared with each of these recipes given on second occasion.

Each one of these preparations was so designed as to provide 50g. of carbohydrate and 350 calories. Blood samples were obtained at half-an-hour intervals from 0-2 hrs. Total area under the plasma glucose curve (AUC) was calculated for each of these recipes and glycaemic index was calculated based on the area comparison with 50 g. glucose load.

The AUC and C max of all test preparations were significantly lower as compared to 50 g. glucose load. Glycaemic index, AUC and C max obtained with test preparations were similar except for bread which was significantly low as compared to ragi roti. The total weight of the cooked preparations varied from 100-250 g. depending on the water content. The satiety values of idli and upma were higher as compared to others.

Further studies on other food preparations based on millets, legumes, pulses, groundnuts and fibre containing vegetables are required to identify low glycaemic index of commonly consumed food items.

PATTERNS OF SALT CONSUMPTION

Common salt constitutes one of the important ingredients in man's diet. Its role in maintenance of human health, especially in water homeostasis, has been well known to physiologistss and physicians. But as an article of diet, it gained importance when nutrition scientists considered common salt for using as a vehicle to supply missing nutrients through fortification programmes. Containment of iodine deficiency (goitre) and iron deficiency (anaemia) among certain population groups in India through salt fortification programmes are the two classical examples in this regard. The reasons for the choice of common salt as a vehicle for these purposes are well documented. Recently a decision has been taken by the Health Ministry to iodize all edible salt in India for more effective control of iodine deficiency disease which has been found to be more widespread in the country than hitherto believed.

The National Nutrition Monitoring Bureau, during the year 1982-83 collected data on consumption of salt, as a part of its routine food consumption surveys by weighment method. A total of 1400 rural households were covered from the States of Kerala, Tamil Nadu, Andhra Pradesh, Maharashtra, Gujarat and West Bengal.

The average consumption levels showed a large interstate variation ranging from 3.3 g/cu/day in Gujarat to 20.1 g/cu/day in West Bengal. The consumption level in Tamil Nadu was 19.5 g/cu/day followed by Andhra Pradesh (12.3 g/cu/day), Kerala and Maharashtra (8.9 g/cu/day) each. The overall mean consumption level was about 12 g/cu/day.

In about 55% of the total 1400 households surveyed, the salt consumption ranged between 5 and 15 g. while another 16% households consumed less than 5 g/cu/day. Barring a small percentage of 3% households, which showed very high consumption level of more than 30 g/cu/day, the remaining 25.5% of the households fell within the consumption range of 15-30 g/cu/day.

The pooled data for all states on consumption of salt were analysed according to the income status of the households. It was observed that in the lowest income group (less than Re.1/- per caput/day), the salt intake was highest (15.6 g/cu/day), while in the other income groups the consumption levels were found to be almost similar (10.2 to 11.5 g/cu/day).

TRAINING PROGRAMME

The Fifteenth Annual Certificate Course on Endocrinological Techniques will be held between 4th August 1986 and 19th September 1986. Ten participants from different parts of the country will attend the course.

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CURRENT TOPIC

MEASLES - MALNUTRITION - BLINDNESS

Measles is an acute viral infection resulting in eruptions on the skin in childhood and is a universal disease. Children below the age of 5 years are mainly susceptible to it and the attack rate is as high as 95-100%. Though only one strain of measles virus is known so far all over the world, the epidemiological pattern and severity of the disease vary from country to country. Outcome of the disease depends to a large extent on climatic, environmental, genetic and racial factors as well as availability of health care facilities.

Measles is considered as an outstanding health problem in the developing regions of the world, being particularly severe in densely populated countries. The disease is reported as exceptionally severe among African children with mortality rates of 25-50% during epidemics. Associated malnutrition has been observed to be responsible for this serious outcome. Besides, measles can precipitate severe protein energy malnutrition in a significant proportion of children. Postmeasles blindness is a much feared complication.

In most parts of India measles is endemic and malnutrition is a co-existent public health problem. Recent studies conducted at the National Institute of Nutrition highlight the effects of measles on the morbidity and nutritional status of young children which help to explain the mechanism of the interactions between measles and malnutrition.

The observations made in these studies suggest the importance of controlling measles by routine immunization of all susceptible children to control severe malnutrition, morbidity and blindness following measles.

The magnitude of the problem of measles was examined among children aged upto 5 years in an urban slum in Hyderabad city. Nutritional status was assessed by anthropometric methods before, during and after measles. Immunological studies were carried out to investigate the effect of malnutrition on the course and severity of measles.

Epidemiological Features

Measles showed a typical seasonal pattern with peak incidence between the months of March and May, the dry and hot months of the year in India. With the onset of rainfall in June, the incidence dropped significantly, rising again from October onwards to reach the peak during the hot season of the subsequent year. The incidence was higher among children below 2 years. Nearly 22% of the cases suffered from measles during infancy thereby indicating the unhygienic environment and overcrowding that are conducive for the spread of the disease to a younger infant. About 9.5% of the susceptible children (those who had not had measles earlier) suffered from the disease by 5 years of age. These observations indicate the extent of the problem ranging from infancy to 5 years of age.

INTERACTIONS BETWEEN NUTRITION AND MEASLES

Effect of nutrition on the course of measles:

The incidence of measles was found to be similar among children belonging to various nutritional grades. The duration of illness as judged by the duration of cough, rash and fever were also comparable between the wellnourished and malnourished children. About 60% of the children had associated bronchopneumonia or diarrhoea during measles. In 14% both the complications were present. About 25% required hospitalisation due to severity of associated complications. However, the proportion of children having one or both the complications or those with severe measles requiring hospitalisation was the same between the wellnourished and the malnourished groups.

Immunological basis for recovery

Recovery from measles depends upon the cell-mediated immune status of the individual. Severe measles leading to high fatality rates and prolonged excretion of virus through nasal secretions from malnourished children with measles have been reported from African countries. However, the experience from Asian countries appears to be different.

Cell mediated immune response to measles virus in children belonging to different nutritional grades was investigated and correlated with the clinical course and severity of the disease. The specific cell mediated immune response to measles antigen was satisfactory among malnourished children and was not different from that of the wellnourished children. Humoral response was also adequate and all the children developed protective titres of antibodies against measles virus (Fig.1).

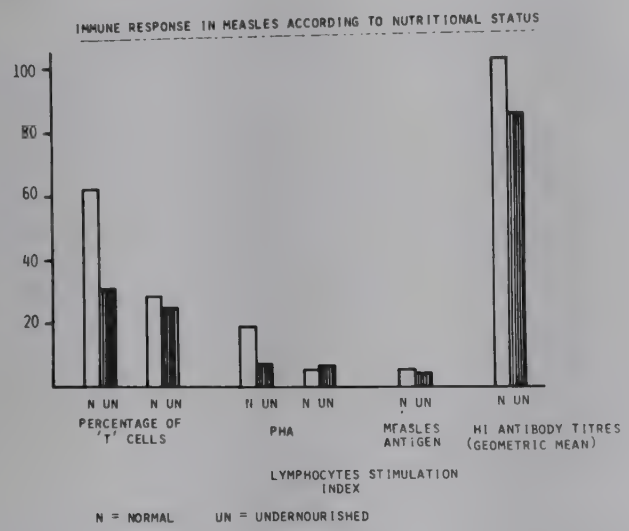


Fig. 1

These observations support the clinical data and explain the similar course of the disease in both wellnourished and malnourished children. It is established that severe malnutrition produces immunosuppression among children with or without measles. But it does not seem to affect the specific immune response in measles. These observations are different from the reports from African children and further studies are needed to explore the possibility of genetic and racial factors responsible for the differences observed.

Effect of measles on nutritional status

Measles is often recorded as a common cause precipitating severe forms of protein energy malnutrition (PEM) viz., kwashiorkor and marasmus. Data collected from the history of children presenting with such severe clinical forms of malnutrition indicated that nearly 25% of them had measles within 1-6 months prior to their illness. Though the immediate preceding factor was either diarrhoea or bronchopneumonia, history of measles followed by recurrent episodes of infection was a common observation in all these children.

Serial weight recordings indicated a significant decrease in weight during measles compared to the weight, recorded 5-7 days prior to the acute episode. Serial weight recordings on 300 children who had suffered from measles indicated weight loss ranging from 2 to 12% of the body weight during the acute phase of illness. Weight gain in them was significantly lower during the initial 3 months of post-measles recovery period compared to matched control children living under the same socio-economic conditions. There was a significant deterioration of the nutritional status of the children after measles (Fig.2) and 4% of them developed clinical signs of PEM manifesting as kwashiorkor and/or marasmus within 6 months of the post-measles period.

Serum albumin levels dropped significantly during the acute phase. Though the wellnourished children also had weight loss during acute illness and slower weight gain during the convalescence phase, none of them shifted to severe grades of malnutrition. However, all the children in whom kwashiorkor and/or marasmus was precipitated, were undernourished before the

CENTRESPREAD

Data presented in the centrespread pertain to the growth status (Gomez Classification, weight-for-age) of 1-5 year old children and their dietary status (in terms of calorie-protein adequacy) of individuals belonging to the different socio-economic groups in Calcutta (West Bengal). The urban data are compared with those obtained on rural population of West Bengal.

Growth status of urban preschool children

The percentage prevalence of severe degree of malnutrition was found to be highest in industrial labourers (IL) group 8.9%, followed by slum 7.8% and 6.6% in rural children. It was lowest in low income group (LIG) 3.6%. In middle income group (MIG), none was suffering from severe degrees of malnutrition.

Dietary Status

The percentage of individuals consuming diets inadequate in proteins and calories was around 13.0% in LIG as well as rural groups followed by slums (11.0%). In MIG and IL it was around 4.0%.

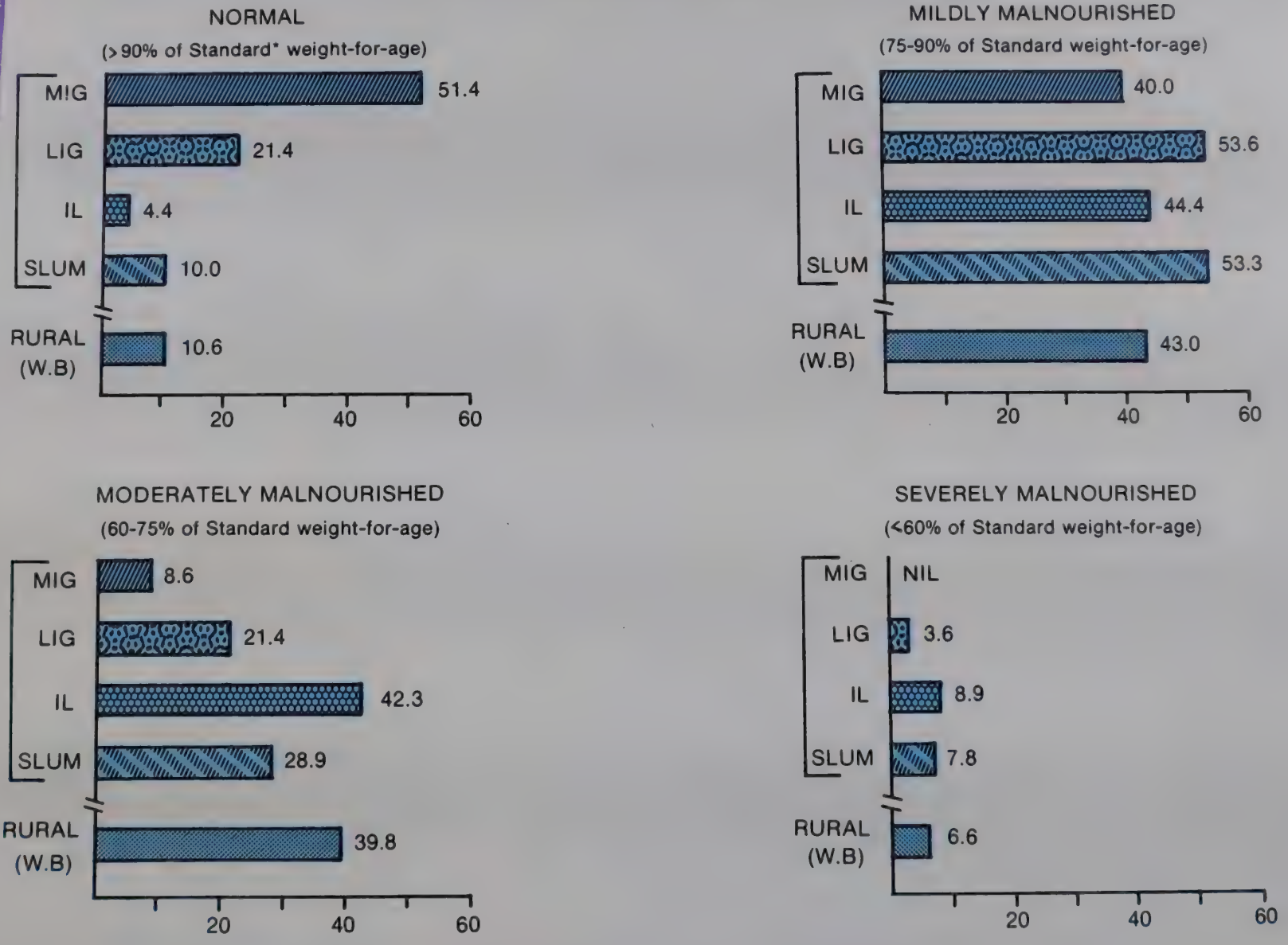
C.F.T.R.I., MYSORE
20 NOV 1980

PERCENTAGE DISTRIBUTION OF CHILDREN (1-5 YRS) IN CALCUTTA (WEST BENGAL) ACCORDING TO GRADES OF MALNUTRITION

(Source : NNMB Surveys, 1975-80)

Number of Children surveyed in High Income Group (HIG) was small for Analysis

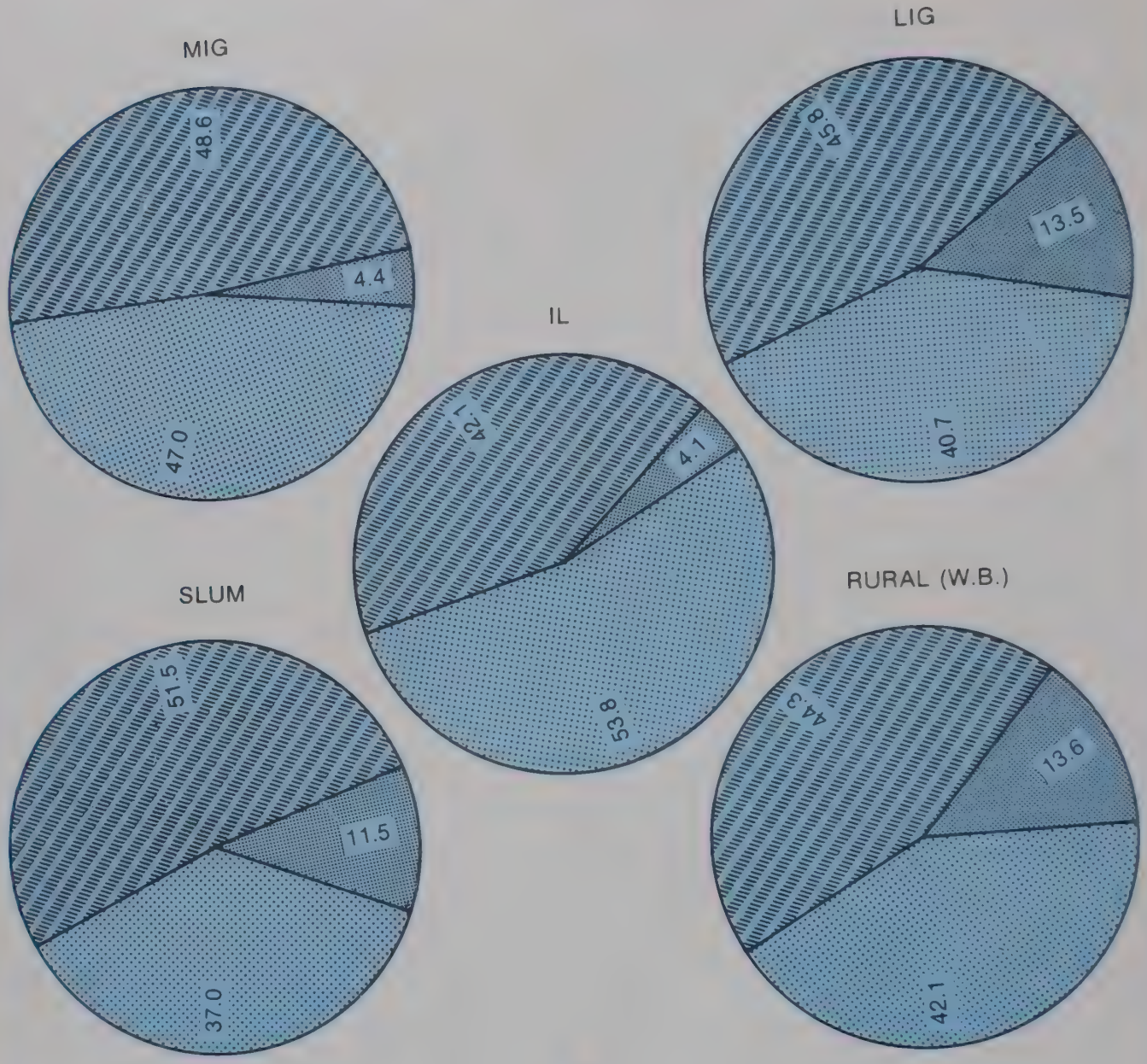
*Standard : Well-to-do Indian children



MIG : Middle Income Group IL : Industrial Labourers LIG : Low Income Group

CALORIE PROTEIN INTAKE STATUS OF INDIVIDUALS (PERCENTAGE) FROM DIFFERENT SOCIO-ECONOMIC GROUPS IN CALCUTTA (WEST BENGAL)

(Source : NNMB Surveys, 1975-80)



MIG : Middle Income Group LIG : Low Income Group IL : Industrial Labourers

Number of Individuals Surveyed in High Income Group (HIG) was small for Analysis

development of the illness. These observations establish that, even though the adverse effects of measles are felt by wellnourished as well as malnourished children, the severe consequences are however felt more frequently by children who have been chronically malnourished. Therefore the nutritional status of the child at the time of illness appears to be a critical determinant of the subsequent growth rate.

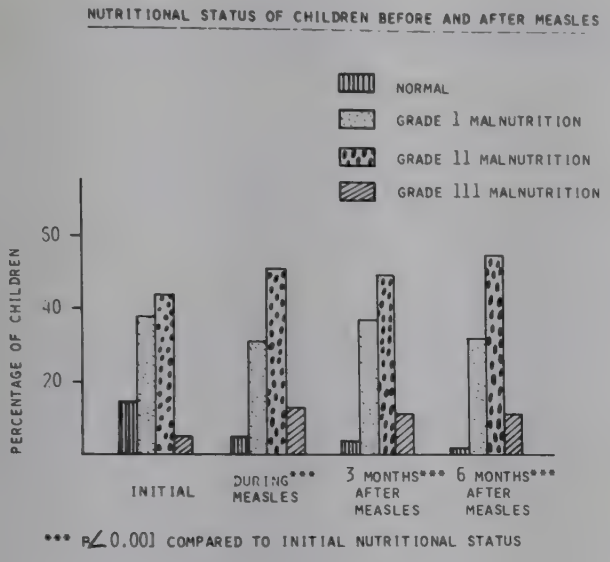


Fig. 2

Measles and the immune system

Immunological studies carried out during measles clearly indicated severe suppression of cell mediated immune status as observed by decrease in the percentage of T cells in circulation as well as the *in vitro* proliferative response of these cells to stimulation with mitogen like phytohemagglutinin. The immunosuppression was observed uniformly in all children with measles irrespective of their nutritional status. There was no additive effect of malnutrition on the measles induced immunosuppression. These effects of measles *per se* on immune system explain the occurrence of associated infections during and after measles uniformly in all children irrespective of their nutritional status

However, the consequences are obviously worse in an undernourished child who is already handicapped. There were no deaths due to measles during the study period. This could be due to the timely medicare provided to these children. Adequate health care facilities could reduce the severity of the disease and its associated mortality. But, adverse effects on the nutritional status, morbidity and other complications remained unchanged.

These interactions between malnutrition, measles and immunity demonstrate the adverse effects of measles *per se* on morbidity, growth and nutritional status of the child. Though nutritional status does not alter the course of measles *per se*, it perhaps determines the post-measles consequences. In an already undernourished poor child living in unhygienic environment, measles succeeds in establishing the vicious cycle of malnutrition, immunosuppression and infection

Corneal lesions in measles

Post-measles corneal lesions leading to blindness have been reported from various developing countries. In the present study, 3.1% of the children developed corneal lesions ranging from corneal xerosis to corneal ulceration during measles. Presence of these lesions during the acute phase of measles and their absence in the post-measles period indicated the role of measles virus *per se* in the aetiology of these lesions. Presence of lesions of superficial punctate keratitis which is established as measles viral keratitis were observed in 50% of the children during the period of rash. Pathogenic bacteria were isolated from the eye swabs obtained from children with measles more often than in control children. The immune factors of tears - SIgA and lysozyme were low in the former group. Serum vitamin A levels diminished in all children with measles. Development of corneal lesions, had no association either with the nutritional or serum vitamin A levels of the child. This finding is different from the commonly observed association between keratomalacia of nutritional origin with severe protein energy malnutrition and hypovitaminosis A.

These observations lead to the hypothesis that measles virus *per se* produces keratitis which makes the corneal structure vulnerable for further trauma. The local immune factor deficiency in the eye associated with measles triggered growth of pathogenic organisms that damage the cornea which is already made susceptible by the viral keratitis and the altered vitamin A status (Fig.3).

Pathogenesis of eye lesions in measles

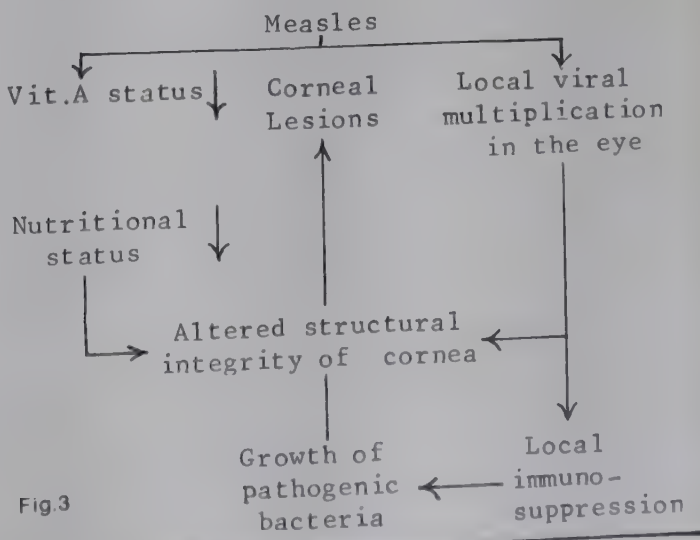


Fig.3

All these sequelae caused by measles *per se* highlight the severity of this problem among children below 5 years of age and emphasise the need for routine measles vaccination of all the susceptible children.

Dr. P. Bhaskaram

RESEARCH NOTES

MYCOTOXINS AND PELLAGRA

Pellagra is more common in individuals who consume jowar as a staple cereal with limited amount of animal proteins in the diet. Earlier studies from this Institute indicate that the development of niacin deficiency in Jowar eaters could be attributed to aminoacids. Mycotoxins can also interfere with niacin nutritional status resulting in pellagra. Hence an experiment was conducted to evaluate the effect of aflatoxin on nicotinamide nucleotide concentrations in liver in rats. Using labelled niacin, nucleotide levels were estimated and the liver pools of niacin were estimated. The results indicate that feeding of aflatoxin had no effect on the uptake and incorporation of labelled niacin into nicotinamide, nucleotide such as NAD, NADP, NM. Though slight decrease in liver niacin pool was observed, the effect of aflatoxin and tryptophan, niacin metabolism appears to be a generalised toxic effect on liver, with no change in the enzymes of nicotinamide, nucleotide synthesis. It may be concluded that mycotoxin contamination of the staple cereal is unlikely to interfere with niacin nutritional status.

EFFECTS OF VITAMIN D IN DIABETES

Vitamin D metabolism has been shown to be altered in experimental diabetes. An improvement in glucose tolerance test (GTT) has also been reported in experimental diabetes on vitamin D administration. Insulin secretion depends on the ionic calcium concentration of the target cell, i.e., β cell of pancreas, which in turn is influenced by vitamin D and its active metabolites. Receptors for 1,25-dihydroxy cholcalciferol ($1,25\ (OH)_2\ D$) are also shown to be present on the β cells of pancreas.

An investigation was carried out to assess the beneficial effects of vitamin D administration in human diabetes. A total of 35 diabetes patients attending the diabetes clinic of local general hospital were selected for the study. Of them, 22 were cases of noninsulin dependent diabetes mellitus (NIDDM), eight were insulin dependent diabetes mellitus (IDDM), 2 were brittle and 3 were newly discovered diabetes.

Fasting blood samples were obtained at hourly intervals and GTT was done. Each subject was given 300,000 I.U. of vitamin D intramuscularly. GTT was repeated again after 4 weeks after D administration.

Blood glucose, calcium, phosphorus and cholesterol were also estimated. The results indicate that amongst diabetics studied, highest percentage of patients were of NIDDM type and the lowest from IDDM (juvenile and adult) type.

There was a definite and significant improvement in GTT in all the diabetics with vitamin D administration. There was a significant increase in serum calcium levels and a significant decrease in serum phosphorus and cholesterol levels after vitamin D administration.

It can be concluded from the results that administration of a large dose of vitamin D has a definite effect in improving the GTT in diabetics. The mechanism of this action is however not clear and it is being investigated.

TRAINING PROGRAMMES

The 3-month Twentyfourth Annual Certificate Course in Nutrition will commence from Ist December 1986. Around eighteen medical officers/teachers in medical schools from different states of India are expected to participate.

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WE WISH ALL OUR READERS A HAPPY NEW YEAR

CURRENT TOPIC

DOUBLE FORTIFICATION OF SALT WITH IRON AND IODINE TO CONTROL ANAEMIA AND GOITRE

Iron deficiency anaemia and its control through iron fortified salt

Iron deficiency anaemia is a major nutritional problem in our country. The vulnerable groups most affected are women of reproductive age, pregnant women and preschool children. Its prevalence ranges from 60-70% both among women and children and 30-40% among adult males and older children in most parts of our country. The major cause of anaemia in our country is iron deficiency due to inadequate intake of dietary iron and/or its poor absorption from predominantly cereal based diets consumed by our population. One of the practical methods to combat and prevent iron deficiency anaemia is to increase iron intake in the diet through fortification of a universally consumed dietary article with iron. In the Indian context, salt has been identified as a suitable vehicle for fortification as it is consumed by all segments of population in a fairly uniform quantity. As the cooking salt used in India is fairly crude with high moisture content, its fortification with iron poses a technical challenge. After a series of laboratory studies, a successful process for the fortification of edible salt was developed at the National Institute of Nutrition. The formula developed for fortification of salt with iron is given in Table-1. The absorption of iron added to salt when consumed along with a cereal based meal was found to be satisfactory (around 5%). Iron fortified salt was acceptable as a cooking salt in the place of ordinary salt. Salt fortified with iron according to the above formula was tested among anaemic children living in an institution and also in a multicentric trial both among rural and urban communities. When consumed over a period of 12-18 months, iron fortified salt was found to reduce prevalence of anaemia significantly. Fortification of salt with iron has been accepted by the Government as a public health approach to reduce prevalence of anaemia. The iron fortified salt is now being introduced on a pilot scale in two districts of Tamil Nadu through public distribution system.

Table - 1

The formula of iron fortified salt

	g/kg.
Ferrous sulphate	3.2
Sodium acid sulphate	5.0
Orthophosphoric acid (or $NaHPO_4$)	3.2

Goitre and iodine deficiency diseases (IDD) and their control through iodized salt

Another major nutritional disorder arising from deficiency of a micronutrient is goitre caused by iodine deficiency, which has been known for several decades as being endemic in the Sub-Himalayan States of India, from Kashmir to Nagaland affecting nearly 120 million people. Iodine deficiency leads to goitre, enlargement of thyroid gland, mental retardation and cretinism in infants and children.

Distribution of iodised salt has been recognised as an effective means of controlling goitre and this approach has been successfully used in many parts of the world, where goitre is endemic. In India, the effectiveness of iodised salt to control goitre was demonstrated in Kangra valley in mid 50s. Following this pilot study, government took a national policy decision to control goitre through distribution of iodised salt. This national programme is administered through Directorate General of Health Services of the Central Health Ministry. However, the production of iodised salt did not keep pace with the

requirement (0.2 million tonnes as against 0.6 million tonnes). Operational difficulties such as inadequate production, difficulties in prevention of sale of uniodised salt in endemic areas resulted in this programme having little impact on the goitre problem in the country. Further, recent surveys have identified new pockets of IDD and goitre in the nonendemic areas of the country in parts of Gujarat, Madhya Pradesh, Maharashtra and Kerala, particularly in tribal areas. This has led to a realisation that IDD is much more widespread in India than hitherto believed. In view of these developments and in view of difficulties faced in iodizing only part of edible salt to supply exclusively to endemic areas, it has now been decided as a national policy to fortify all edible salt in the country in a phased manner by 1993. If this policy is implemented no non-iodized edible salt can be distributed or sold in India after 1990. On the basis of this decision, production and distribution of iron unfortified salt would not be permitted. It has now become necessary to fortify salt with both iron and iodine to combat anaemia which is prevalent almost all over the country and goitre which is endemic in certain areas. It is gratifying to report that our efforts at NIN during the last 2 years have been in developing a technology to fortify edible salt with both iron and iodine.

Double fortification of salt with iron and iodine

Our first attempt in this direction was to explore the possibility of adding iodine to salt fortified with iron, for which a process was developed earlier. It was observed that iodine was highly unstable when added in the form of KI, KIO_3 or $CaIO_3$ to iron fortified salt at a level of 25 ppm, though it did not develop any colour. The iodine levels decreased rapidly within 2-3 days of storage, irrespective of the source of iodine. Calcium carbonate is usually incorporated into iodised salt to enhance the stability of iodine. However, addition of $CaCO_3$ at a level of 200 ppm along with KIO_3 to iron fortified salt did not prevent rapid loss of iodine. Hence, it became necessary to develop an alternative process to fortify salt with both iron and iodine ensuring desired stability and bioavailability of both the nutrients.

A number of stabilizers had been demonstrated earlier in the laboratory to improve iron bioavailability.

These were tested at different levels in the salt fortified with $FeSO_4$ and KI or KIO_3 to obtain a product without any colour development and stability of iodine even under humid storage conditions. As a result of these persistent efforts, it was possible to identify a stabilizer which when added to salt at 1% could prevent loss of iodine when stored for several months. The formula finally developed is given in Table-2. The doubly fortified salt remained without any colour development when stored for 12 months or more under high humidity conditions. Iodine estimations indicated no loss of iodine from salt upto 6 months of storage. After 12 months, however, the iodine level decreased to 25 ppm. This level is much higher than the minimum level (i.e., 15 ppm) needed for the prevention of goitre. Loss of iodine to this extent occurs on storage even when salt is fortified with iodine alone. Our observations on the stability of iodine in the double fortified salt is given in Table-3. The absorption of iron from the stored salt was nearly 6% when consumed with a rice based meal and the iron remained soluble throughout this period. Salt from different sources could be fortified according to this formula without any colour development. The iodine in the doubly fortified salt was also fully available when measured in human volunteers. As a result of sustained research at the Institute, a successful method for fortifying salt with iodine and iron has been developed with the desired characteristics. The doubly fortified salt contains 1 mg/g iron and 40 ppm iodine with 1% stabilizer which is a permitted food additive.

Table - 2

The formula of salt fortified with iron and iodine (double fortification)

	g/kg.
Iodine (KI/KIO_3)	0.04
Ferrous sulphate	3.20
Stabilizer	10.00

Table - 3

Stability of iodine in iron and iodine fortified (double fortified) salt

Period of storage (months)	Iodine (KI/KIO_3) ppm
Initial	40
3	40
6	40
9	30
12	25

Tests conducted among a number of families of different socioeconomic status confirmed that this doubly fortified salt was readily acceptable and compatible with most commonly used dishes. It could replace unfortified salt in the normal cooking. Preliminary experiments have been done to prepare the double fortified salt on a larger scale by batch process using the spraying technique.

DISTRIBUTION OF RURAL CHILDREN (1-5 YEARS) ACCORDING TO 'STUNTING' AND 'WASTING' CLASSIFICATION (WATERLOW) - TIME TRENDS IN ANDHRA PRADESH

(Source: NNMB Surveys)

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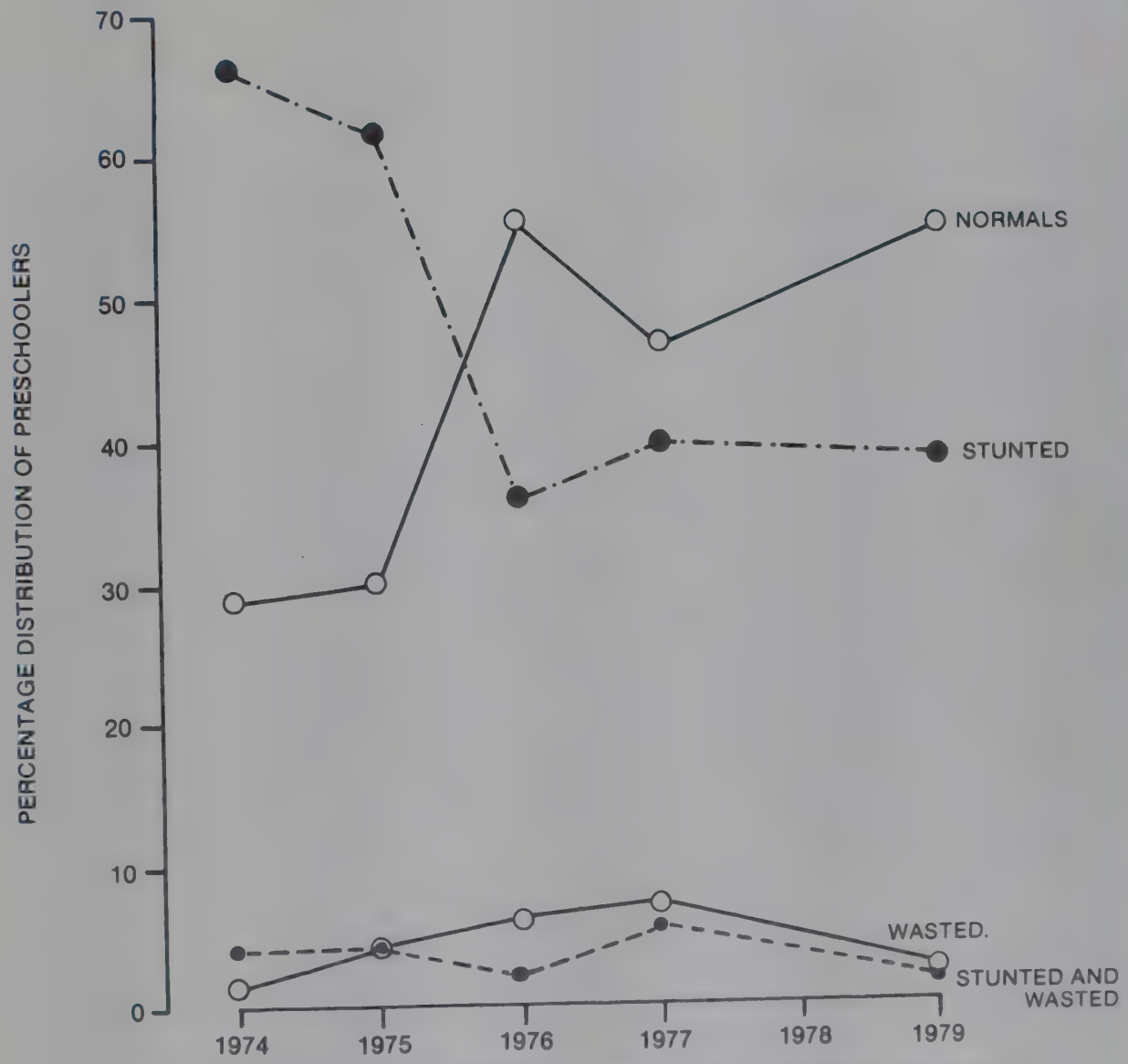
GIRLS



Median Values of Heights and Weights of Well-to-do Indian children are used as standards.

'Stunting' : Children having height for age less than 90% of standard value.

'Wasting' : Children having weight for height less than 80% of standard value.

'Normals' : Children who did not exhibit 'stunting' or 'wasting'.

DISTRIBUTION OF RURAL CHILDREN (1-5 YEARS) ACCORDING TO 'STUNTING' AND 'WASTING' CLASSIFICATION (WATERLOW) - TIME TRENDS IN ANDHRA PRADESH

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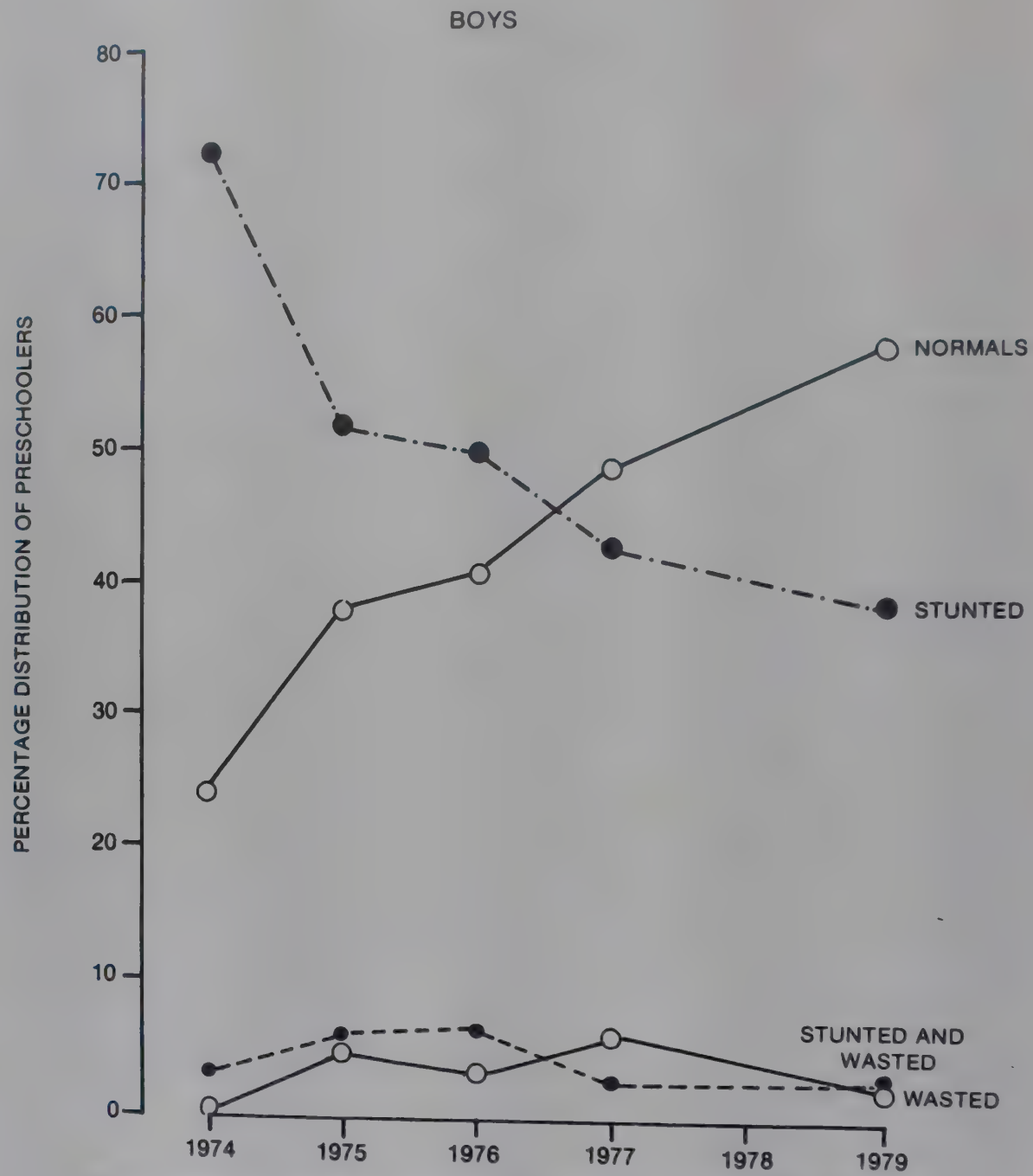

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Field trials with the double fortified salt

The doubly fortified salt is to be field tested for its effectiveness in controlling anaemia and iodine deficiency in a community where these disorders are prevalent. Community trials are proposed to be carried out in two areas - one goitre endemic area in Uttar Pradesh and another newly identified goitre pocket in Andhra Pradesh. The detailed plan and protocols for this trial have been finalised and the trials are to be initiated shortly.

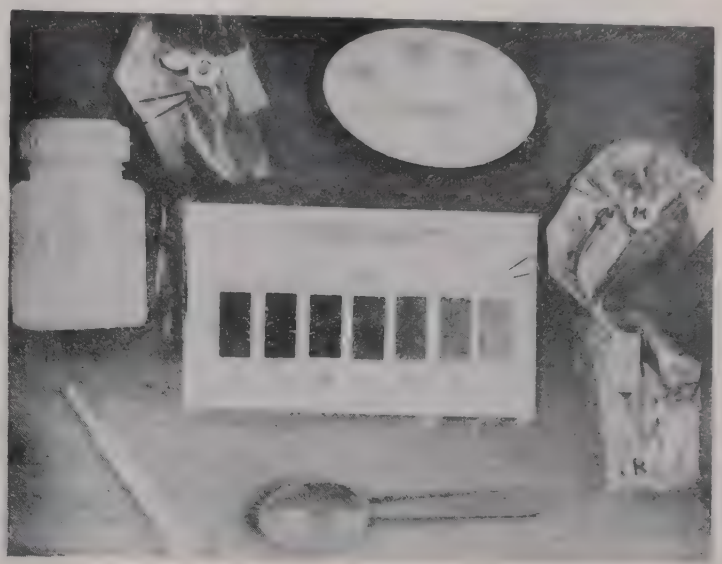
Dr. B. S. Narasinga Rao

A Simple Field Kit for Testing Iodine in Salt

Effective implementation of a programme for iodised salt distribution to control and eradicate iodine deficiency disorders requires regular monitoring of edible salt for iodine, particularly at the retail sales level and the household level. The NIN has developed a simple kit for testing iodine in salt. This kit can be used even by field workers who have no knowledge of chemistry.

The kit (as shown in the Figure) consists of :

1. Distilled water container (500 ml).
2. A white plastic plate with circular depressions.
3. Plastic droppers.
4. Plastic spoon.
5. Tablet N (soluble starch 200 mg and oxalic acid or citric acid 300 mg), Tablet R (potassium iodide 1 g.) and Tablet S (soluble starch 250 mg, sodium nitrate 10 mg and oxalic acid or citric acid 250 mg). (Contd. Pg. 4)



INDIGENOUS PRODUCTION OF IODISED OIL FOR THE CONTROL OF GOITRE

As indicated elsewhere in this issue, goitre and iodine deficiency disorders (IDD) have been known to be highly endemic in Sub-Himalayan regions of our country. Recently, several new pockets of IDD have also been identified in other regions of the country. A national programme to control goitre through distribution of iodised salt is currently in operation. Administration of iodised oil orally or through injection has also been suggested as an additional measure for the rapid control of cretinism due to goitre in areas of high endemicity. The efficacy of iodised oil for controlling goitre has already been demonstrated in many countries.

Currently the iodised oil known as 'Lipidol' is manufactured only in France from poppy seed oil. If iodised oil is to be used in our country for the control of goitre, a large amount of the iodised oil has to be imported. There have been attempts by several countries to prepare iodised oil indigenously. In the light of current thinking in our country to use iodised oil for controlling goitre as a part of National Goitre Control Programme, there is a need to develop indigenous technology for the production of iodised oil.

Scientists at NIN have been working on a process to produce iodised oil using indigenously available oil. They have now successfully developed a process to produce iodised oil using safflower oil (safola). This iodised oil named 'Iodosola' contains 300 mg iodine per ml of iodised oil. However, the viscosity of the Iodosola is rather high, to be used as an injectable preparation unlike the 'Lipidol' which has a lower viscosity. Iodosola can however be used for oral feeding. NIN Scientists have also developed a method to prepare an ethyl ester derivative of iodised safflower oil which is named as 'Ethyidosola'. This preparation has a lower viscosity, similar to Lipidol and can be used as an injectable. These two iodised oil preparations which have now been prepared on a laboratory scale were found to be quite stable and when stored even at room temperature without loss of iodine or colour development. These two preparations are quite satisfactory for use in the control of goitre either given as an injection or orally. Attempts are currently being made to scale up the production of these iodised oils as a pharmacological product and test their efficacy in the control of goitre, administered through either oral or parenteral route.

Dr. B. S. Narasinga Rao

6. A colour gradation chart for comparing the intensity of the colour.

7. A standard salt containing 15 ppm iodine.

Tablets N and R are needed for iodate test. Tablet S is meant for iodide test.

Iodate Test for Salt containing KIO_3:

1. Prepare the iodate reagent by dissolving one tablet of R in 25 ml distilled water and one tablet of N in 25 ml distilled water in separate plastic bottles (50 ml) provided in the kit.

2. Place on the plastic plate one spoonful of salt to be tested and similar quantity standard salt separately in the depression provided.

3. Add one drop of solution N to the salt samples followed by one drop of solution R.

The wet iodated standard salt will turn greyish-blue immediately and the colour will persist for several minutes before turning brown. If the salt being tested also turns greyish-blue, the unknown sample is also iodated. Rough estimates of the amount of iodine present in the salt can be made on the basis of the colour intensity by comparing with the colour gradation chart.

Iodine test for salt containing KI

1. Prepare the iodide reagent by dissolving one tablet of S in 50 ml distilled water in the plastic bottle.

2. Add, like in the case of iodate salt, solution S to the unknown salt and the standard salt.

The standard iodised salt will immediately turn blue and stay that colour for several minutes before turning grey, after which the colour fades rapidly. If the unknown salt also turns blue, it is an iodised salt. This test cannot be used to measure the relative degree of iodisation because it produces a uniform deep-blue colour over the entire range of recommended concentrations.

In the kit it is proposed that 50 ml of reagent can be used to test about 500 salt samples. Wherever distilled water is not available boiled tap water or boiled well water can be used. The cost of a kit is less than Rs.10/- in India. The expenditure on the kit is non-recurring and therefore the cost of subsequent kits will be less than one rupee.

RESEARCH NOTES

FOOD FOLATE AVAILABILITY IN RATS

Folate deficiency was produced in rats by giving semi-synthetic diet containing sulphasuxidine. After 40 days there was a significant fall in liver folates. For optimal repletion of folic acid in liver, the animals required 20 µg of the vitamin per day. Due to limitations in feeding 20 ug in terms of food folate, a test dose of 10 µg was used for studying food folate availability. Folate from foods such as Bengal gram *(Cicer arietinum)* and spinach was available to the extent of 83-84% whereas Brewer's Yeast folate showed an availability of 56%. The study suggests that rat can be used as an experimental model for studying the food folate availability, since the results obtained closely resemble those obtained with human subjects.

MEASUREMENT OF PLASMA FERRITIN

The feasibility and validity of measuring plasma ferritin in capillary blood samples obtained through finger prick was assessed. Samples of finger prick as well as venous blood were obtained simultaneously from 31 adult subjects. Plasma from venous blood was stored in ordinary or capillary tubes and that from finger prick blood in capillary tubes at -20° C for 2 months. Ferritin concentrations were determined in these plasma samples by enzyme linked immunosorbant assay. Mean values of plasma ferritin concentrations were similar in all the three batches of samples, i.e., venous, venous plasma stored in capillary and finger prick capillary plasma. A highly significant correlation was found between venous plasma, venous capillary and finger prick capillary. Thus it would appear that if stored properly without evaporation, finger prick capillary plasma will be as convenient and reliable as venous plasma samples for ferritin assay. Assay of plasma ferritin using finger prick blood therefore can be conveniently used to assess the storage iron status of the population in large scale field studies.

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NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL.8 NO.2 MAR 1987

CURRENT TOPIC

GLUCOSE METABOLISM IN UNDERNOURISHED PREGNANT WOMEN

A large number of metabolic alterations occur during pregnancy to meet the requirements of growth and development of the foetus. In the normal situation, pregnant women are able to cope with high levels of circulating insulin and they also adapt to high plasma concentrations of placental lactogen, estrogen, progesterone, serum cortisol and lipids to maintain the metabolic homeostasis in the mothers as well as to ensure a favourable environment for the growth and development of the foetus.

Pregnancy is considered diabetogenic since abnormal glucose tolerance curves are observed in the majority of the pregnant women during the last trimester of pregnancy. Normally pregnant women maintain plasma glucose level within a narrow range during the course of 24 hour day. However there is a marked increase in insulin levels after each major meal. Also there is a decrease in fasting blood glucose starting early in pregnancy and maintained at low level till almost delivery. The reason for lower fasting level has been attributed to increased utilisation of glucose by tissues.Glucose forms an important source of energy for the normal growth and development of the foetus. High levels of glucose are required to transport glucose to the foetus across the placenta.

In India, majority of the women belonging to low socio-economic group have chronically low energy intakes.Pregnancy in these women adds to additional stress due to increased requirements of energy for the growing foetus. To what extent the undernourished women are able to regulate the foetal requirements, placental metabolism and their own needs of glucose in the state of chronic semi-starvation is not very clear.It is known that incidence of low birth weight infant is around 30-35% even in women who do not suffer any complications of pregnancy. Whether the alteration in the glucose metabolism in the state of chronic undernutrition in these women is responsible for higher incidence of intrauterine growth retardation (IUGR) is not clear. In the present review, an attempt has been made to discuss the changes in glucose metabolism in the undernourished pregnant women and its effect on pregnancy outcome.

Fasting blood glucose :

Normally,there is a decrease in fasting blood glucose throughout pregnancy which is due to increased peripheral utilisation as well as hemodilution occurring as part of the physiological processes. It has been observed that in undernourished women, mean fasting blood glucose level is significantly lower than in wellnourished women especially in the third trimester.

Almost 58% of undernourished women have blood glucose less than 55 mg/dl.while only 25% have such a level in the wellnourished group.If blood glucose level less than 45 mg/dl ($\leq$ 2 SD of normal mean) is indicative of hypoglycemia,almost 32% of women would have this level of glucose in the undernourished group.

GLUCOSE TOLERANCE CURVES :

Oral glucose tolerance tests :-

Normally there is an impairment of glucose tolerance in pregnancy. It is well known that latent diabetes may become unmasked during pregnancy.

Various factors such as high levels of circulating hormones like placental lactogen, estrogen and progesterone and also corticosteroids are responsible for impairment in the glucose tolerance. Associated with this impairment is also a state of increased circulatory level of insulin. It was observed that in undernourished women, oral glucose tolerance curve was flat as compared to the one seen in women with better nutrition. Also the area under the curve was lower in these women as compared to wellnourished group.

Oral glucose tolerance curve may be influenced by absorption of glucose which would be expected to be affected in undernourished women. Hence intravenous glucose tolerance tests were carried out in these women.

I.V. Glucose tolerance

Like oral glucose tolerance curve, I.V. glucose curve also showed a flattening in undernourished women as compared to wellnourished women.Also it was observed that the area under the curve was lower in undernourished women, similar to oral glucose tolerance.

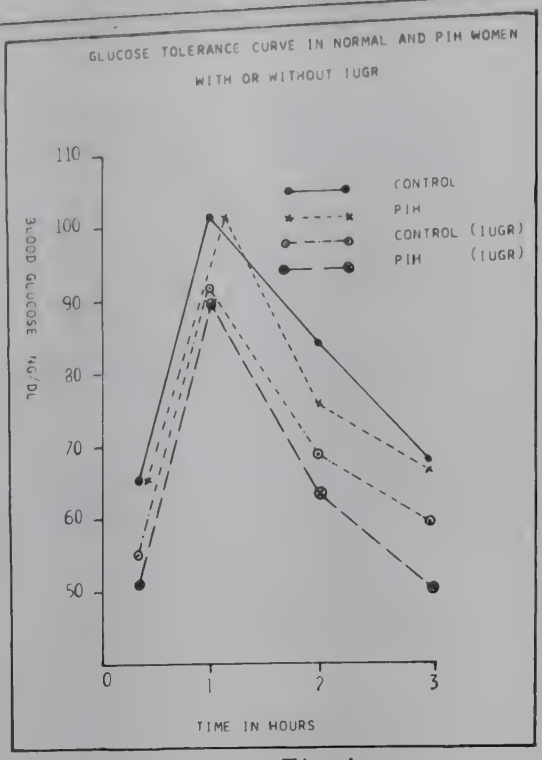

Fig. 1.

Glucose tolerance in IUGR

When the data was analysed with respect to the pregnancy outcome (birth weight of the infant) it was observed that women who subsequently gave birth to low-birth-weight infants (irrespective of cause) had, poor peak response (Fig.1) and lower area under the curve than the women who gave birth to higher-weight infants.These characteristics of the glucose tolerance curve in undernourished women indicates rapid clearance and utilisation of glucose.

Even with I.V. GTT the area under the curve was significantly lower in mothers giving birth to IUGR infants. Also the metabolic clearance rate (MCR) of glucose was higher in these women as compared to women giving birth to better weight-infants (fig.2).

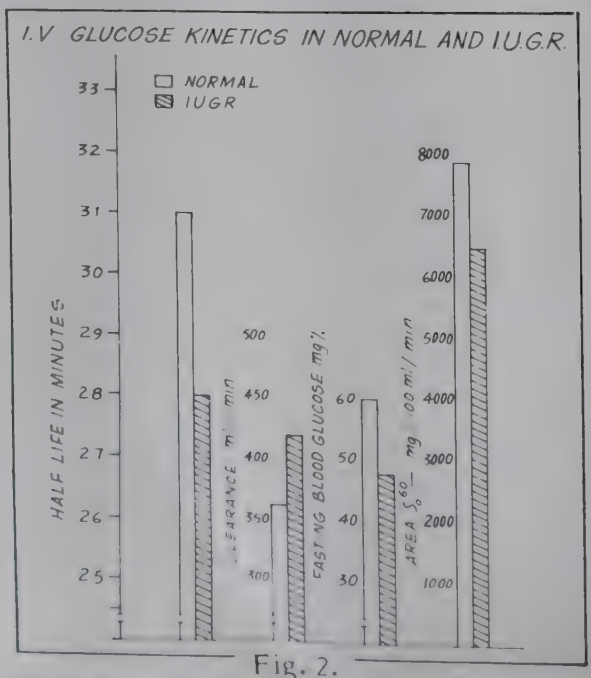

Fig. 2.

The increase in metabolic clearance and low area under the curve in response to oral or I.V. glucose load in IUGR pregnancies could be a mechanism geared to create a better glucose homeostasis in conditions of chronic low energy intakes. Thus faster MCR may be a compensatory mechanism to flood the placental bed with higher amount of glucose to create a higher concentration gradient across the placenta.

Foetus depends mainly on maternal glucose for its energy needs and in IUGR mothers, low fasting glucose may be due to diversion of glucose to the placental tissues as a compensatory mechanism to increase the availability of energy to the foetus.

Since the compensatory mechanism cannot stretch too far due to poor availability of substrates in unfed conditions, foetal energy needs are compromised resulting in growth retardation.

Free Fatty Acids :

It was observed that basal free fatty acid levels were lower in undernourished mothers as compared to wellnourished mothers of similar gestational ages. Normally FFA increases enormously during pregnancy. This increase is attributed to some extent, to the increase in Human Placental Lactogen (HPL) levels and higher circulating insulin levels which have lipolytic action in fasted state to provide energy fuel. Earlier observations suggest that serum HPL levels are lower in undernourished women. To what extent these alterations in hormone patterns alter the metabolic patterns of glucose and FFA in malnutrition is not clearly understood. A comprehensive study is needed to understand the interplay of various factors in regulating the metabolic processes in undernutrition.

FFA response to glucose load :

Normally after glucose load, FFA level decreases and returns to basal value at the end of 2 hours. In undernourished women though basal FFA levels were lower than better nourished women response to glucose load was similar in the two groups of women.

Insulin levels :

In early pregnancy, there is a rise in serum insulin levels due to pancreatic B cell hyperplasia (as a response to elevated estrogens and progesterone), and heightened sensitivity to insulin. These alterations are anabolic and stimulate increased storage of glycogen. In later half of pregnancy, due to increased HPL, prolactin and cortisol there is stress on carbohydrate metabolism resulting in a modest insulin resistance and mobilization of hepatic glycogen in a fed state. The hyperinsulinemia continues in late pregnancy as a response to impaired glucose tolerance.

In undernourished women it was observed that even in non-pregnant state, basal insulin levels were lower (2.4±1.49 μu/ml) as compared to reported figures (5.5 μu/ml). During pregnancy, insulin levels increased and were 12.0±1.30 μu/ml at term. The hyperinsulinemia in these undernourished women (6 fold increase) is more marked than in western women where only 2 fold change occurs in the insulin levels during

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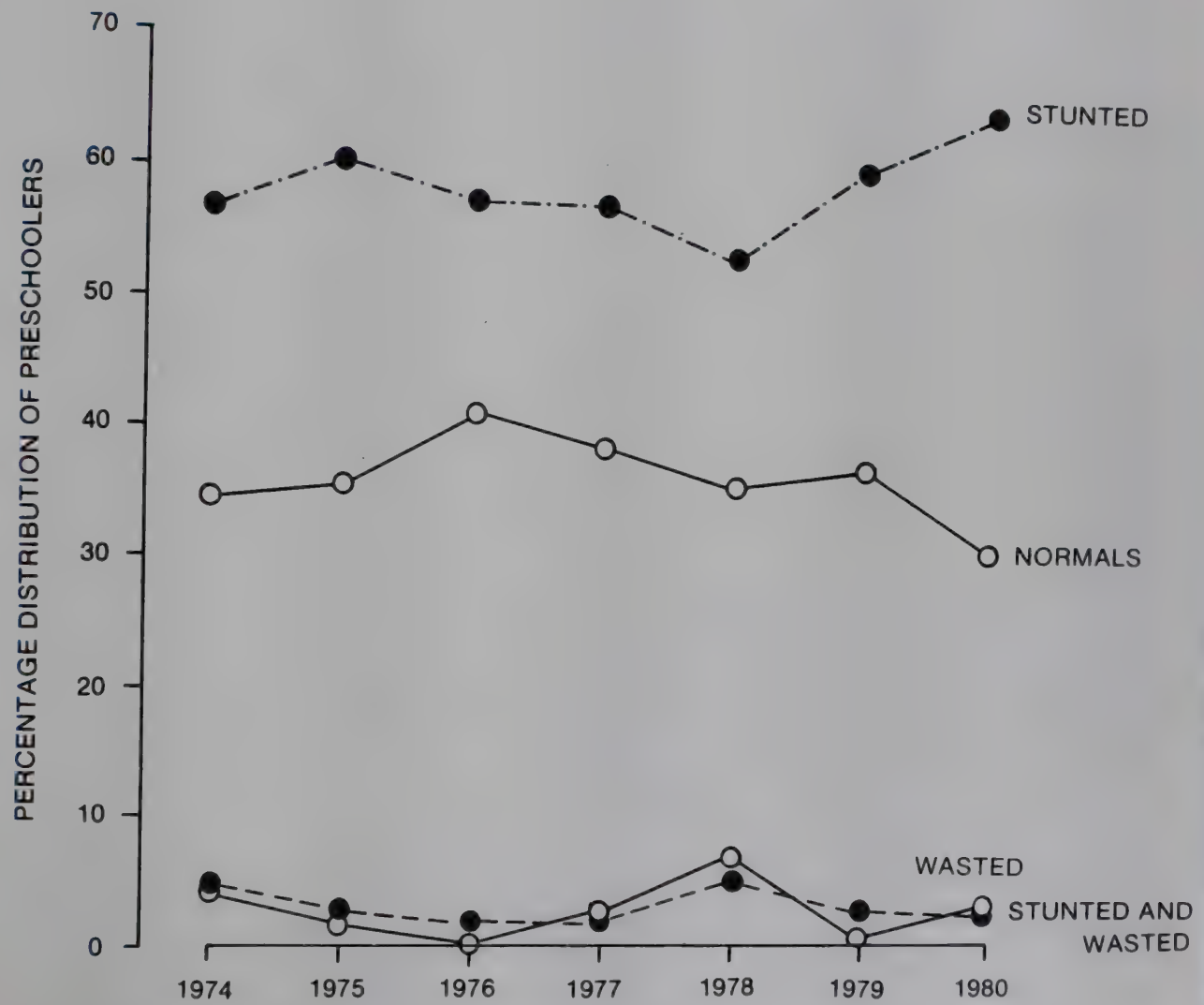
DISTRIBUTION OF RURAL CHILDREN (1-5 YEARS) ACCORDING TO 'STUNTING' AND 'WASTING' CLASSIFICATION (WATERLOW) TIME TRENDS IN GUJARAT

Source : NNMB Surveys)

BOYS



Median Values of Heights and Weights of Well-to-do Indian children are used as standards.

'Stunting' : Children having heights for age less than 90% of standard value.

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DISTRIBUTION OF RURAL CHILDREN (1-5 YEARS) ACCORDING TO 'STUNTING' AND 'WASTING' CLASSIFICATION (WATERLOW) TIME TRENDS IN GUJARAT

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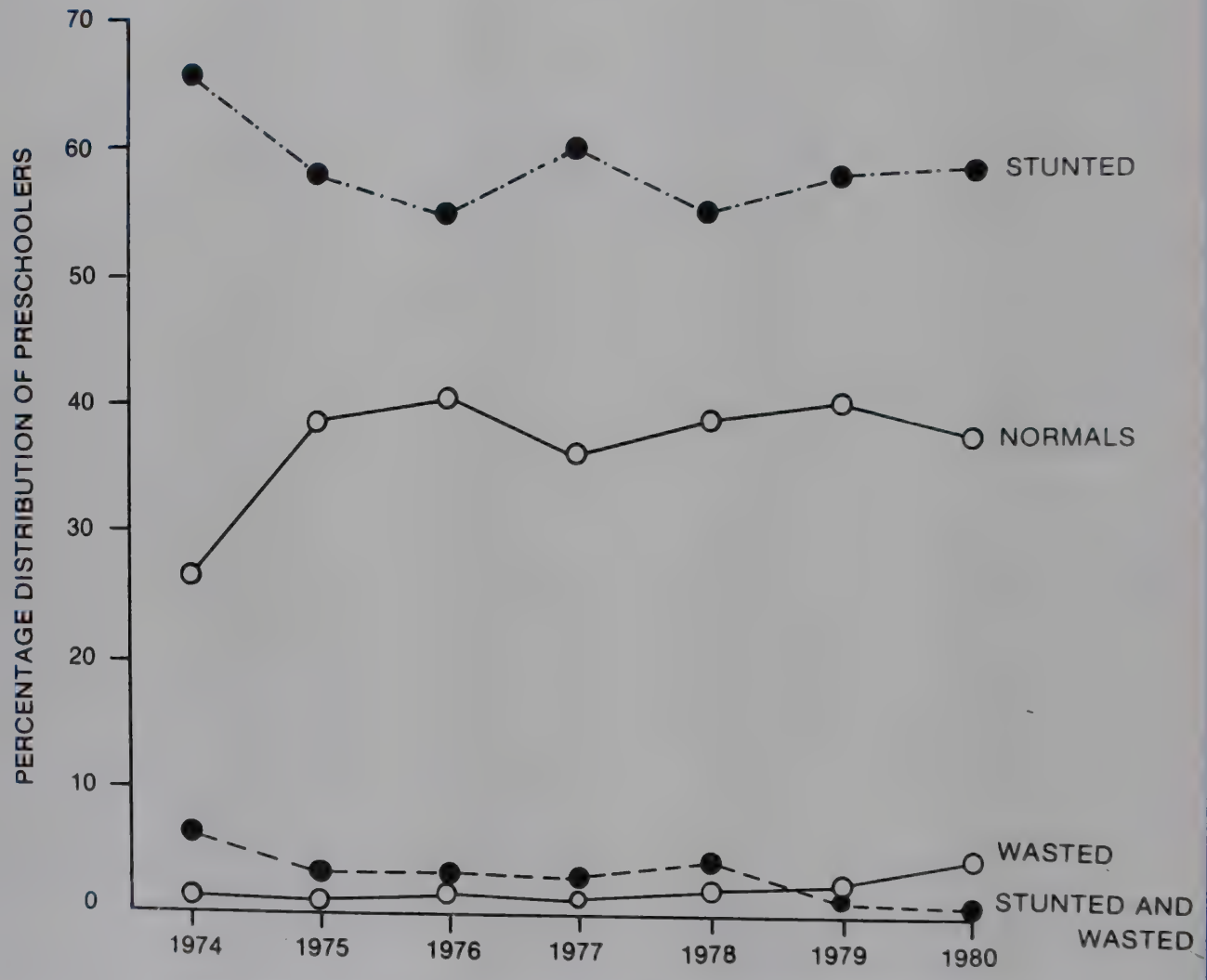
GIRLS



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National Institute of Nutrition, Hyderabad-500 007, India

pregnancy. It is felt that the hyperinsulinemic state could be an adaptive mechanism to mobilise glucose for better placental gradient.

Insulin response to glucose load :

In a recent study it was observed that in underweight pregnant women (<42 kg.) basal insulin was low and also the response to glucose load was relatively lower than the women with better body weights. This relative poor insulin response raises a question as to whether this is an indicator of poor pancreatic stimulation. The area under the curve for insulin also was lower in these women.

Glucose tolerance in pregnancy induced hypertension:

There are conflicting reports in relation to carbohydrate metabolism in severe pregnancy induced hypertension (PIH). Both diabetic and normal responses have been reported to glucose load in this condition. Since most PIH women in India have also associated undernutrition, the study on carbohydrate metabolism was extended in women with severe PIH.

It was observed that similar to undernourished normal pregnant women, mean fasting blood glucose was low in severe PIH. 70% of these women had blood glucose below 55 mg/dl. Both oral and IV glucose tolerance tests indicated a low peak response to glucose loads. Basal FFA levels were lower. After IV glucose load, there was initial decrease in FFA levels which did not return to basal level even after 90 minutes.

Influence of altered glucose patterns on pregnancy outcome:

(a) In PIH:

While in normal pregnancy no deaths were reported due to hypoglycemia, in severe PIH, 39% of the births were premature as against 2.1% in normal women. 14 still births occurred in PIH. Figure 3 shows the foetal outcome in severe PIH in relation to maternal blood glucose. 51% of the mothers delivering prematurely had blood glucose levels ∠-2SD of normal mean (∠ 45 mg/dl), while only 25% had premature deliveries when glucose level was normal or -1SD.

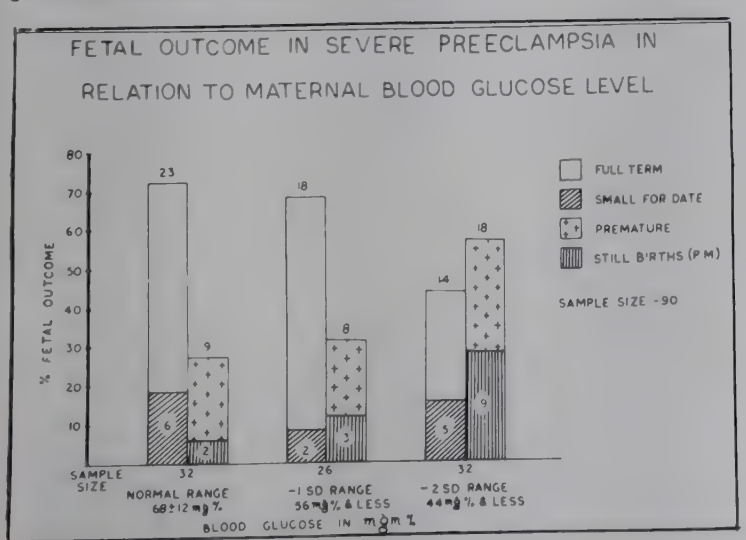


Fig. 3.

Similarly, of the 14 still births in severe PIH, nine mothers (64.3%) had blood glucose ∠45 mg/dl while only two mothers had normal level and three had ∠55 mg/dl glucose levels. These still births occurred within 72 hrs. of measuring the blood glucose levels.

In severe PIH, hypoxia of severe degree is seen due to poor placental function. Hypoglycemia in addition seems to aggravate the hypoxic state resulting in acute anoxia and death of the foetus or results in premature delivery.

(b) Normal women :

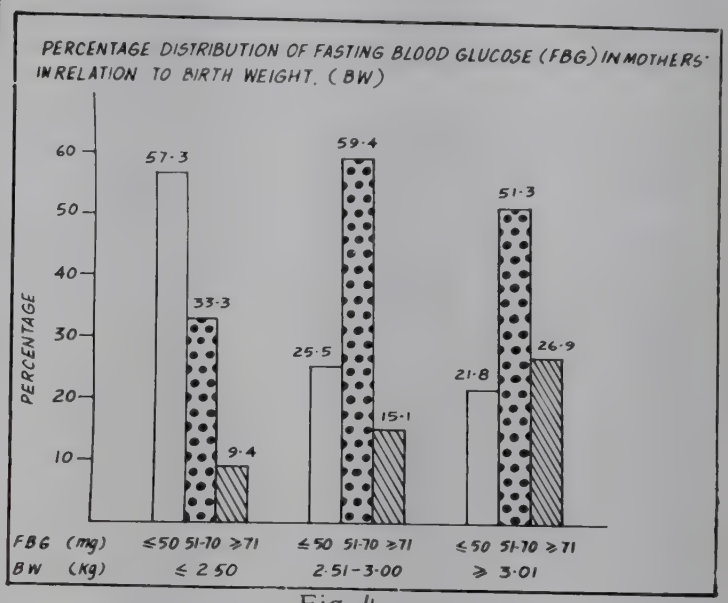


Fig. 4.

Fig. 4 shows the frequency distribution of birth weights in relation to different ranges of blood glucose. It is obvious that almost 60% of the mothers having blood glucose less than 50 mg/dl gave birth to low birth weight infants. With increasing levels of glucose, percentage of low-birth-weight infants decreased. Above 70 mg/dl, higher percentage of mothers gave birth to infants with weights above 3kg. indicating that optimal level of glucose above 70 mg/dl is needed for better foetal growth. It is well known that in diabetes, size of the baby is related to hyperglycemia in the mother.

Blood glucose in the new-born :

A close correlation was seen between maternal blood glucose and cord blood glucose (r 0.7589 P ∠0.001). Infusion of glucose to the mothers prior to delivery resulted in increased blood glucose levels in the newborn also. The low blood glucose at birth with poor glycogen reserves commonly seen in low-birth-weight infants subsequently results in hypoglycemia, and death if the neonate does not get fed within 24 hrs. Neonatal hypoglycemia in IUGR infants is a well established observation and defective brain and mental function on account of hypoglycemia have been documented in the literature.

Implications :

Implications of above observations are obvious. In chronic under fed state, mother is not able to maintain blood glucose levels within normal range. Stress of pregnancy with its increased requirements results in readjustment of blood

glucose with (possibly) an attempt to improve placental perfusion. Low blood glucose in the mothers or impairment in placental transfer (as seen in PIH) results in poor transfer of glucose to foetus. Low glucose level in the foetus may result in a poor pancreatic stimulus and low insulin secretion which in turn may be responsible for the features of IUGR i.e. (a) poor fat deposit (b) poor muscle mass and (c) poor hepatic glycogen

- Dr. Leela Raman

RESEARCH NOTES

Mid-Day Meal Programme in Andhra Pradesh :

A study of the Mid-Day Meal Programme,in operation during the second half of 1983, in Andhra Pradesh revealed that the programme awareness was very high, in respect of parents, teachers and village leaders. This programme was studied in 40 government schools - rural areas of the Hayatnagar and Medchal Developmental Blocks of Andhra Pradesh. The survey covered 565 child beneficiaries, an equal number of parents, 107 teachers, 127 community leaders and 25 personnel at different levels of implementation of the programme, using the questionnaire method.

The acceptability of the meal (prepared from rice, dhal, vegetables and oil) by the children was good (more than 90%).Children in the higher classes (class IV and V) found the quantity inadequate (6% and 10% in Hayatnagar and Medchal Blocks respectively). 25% of teachers expressed similar opinion.

A similar percentage of parents, however, commented that the school meal had 'no variety', 'no vegetable' or was 'not tasty'.

Though the cooking site was supposed to be shifted from school to a common community location, in majority of schools, the responsibility for getting the meal cooked as well as supervision of cooking was still on the teachers though the Panchayat representatives were to take over these tasks. Physical facilities like cooking space, utensils were found to be inadequate.

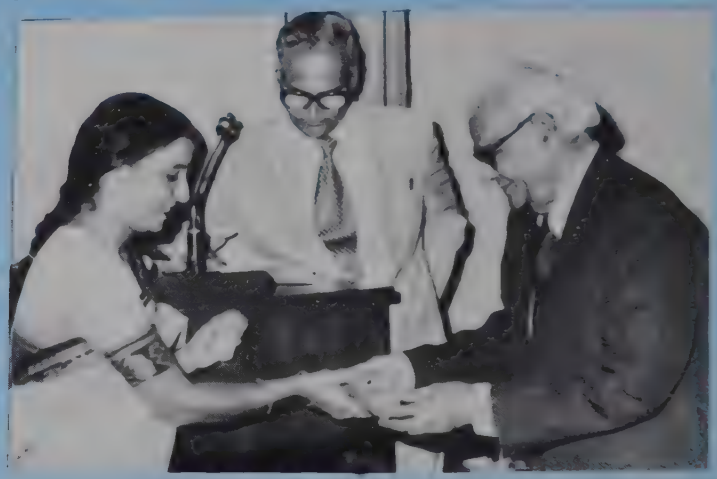
From the response of the teachers, the programme did not succeed in controlling the drop-out rate of school children. The study also revealed the need for effectively using the programme for channelising the health and nutrition education of the school-going children.

TRAINING PROGRAMMES

VALEDICTORY FUNCTION

The valedictory function of the Annual International Training Courses in Nutrition was held at the Institute on 27th February 1987.

Major K.N. Rao, Vice-Chancellor, University of Health Sciences, Vijayawada, Andhra Pradesh, delivered the Valedictory Address. In his address Maj. Rao exhorted the Medical personnel to accord more importance for spreading the message of importance of proper nutrition in maintaining positive health. He stated that thanks to nutrition research various aspects relating to nutrition and health have been brought to light. Nutrition immunity interface is particularly now well recognized. He urged for a closer coordination among State Health Administrators, Nutritionists, Medical fraternity and Social scientists, which he considerd as essential for waging the war on malnutrition and associated health hazards. Dr.Rao awarded the certificates to the successful participants.



In his presidential remarks, Dr.P.L. Sanjeeva Reddy, Principal Secretary to Government, Department of Medical Health, Andhra Pradesh, dwelt on the integrated interdisciplinary approach to medical education and the introduction of a nutrition bias in the medical curricula. He pleaded for an even higher priority for operational research in the activities of Institutes like National Institute of Nutrition.

Six participants in the M.Sc.(Applied Nutrition) Course and eight participants in the Annual Certificate Course in Nutrition received the certificates on the occasion.

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NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL. 8 NO. 3 MAY 1987

CURRENT TOPIC

DIABETES MELLITUS AND FENUGREEK SEEDS

According to the data collected by the WHO, diabetes is the third commonest disease in the world next to the cardiovascular and oncological disorders. Every fifth person in the world is suffering today from diabetes directly or indirectly. Although exact prevalence rate in India is not known, various surveys indicate that about 2-3% of the population suffers from this disease.

Diabetes mellitus is caused by the deficiency in secretion of insulin by pancreatic cells. It is of two types - Type I - Juvenile onset diabetes is insulin dependent and occurs all over the world. Victims are emaciated and insulin deficient. The maturity onset (Type II) diabetes is noninsulin dependent and is the most common form. 90% of the diabetics belong to Type II. Patients retain endogenous insulin production but exhibit excess adiposity and peripheral action of insulin is impeded. The levels of glucose in blood rise in both types of diabetes because of decreased oxidation of glucose. When blood glucose levels exceed the renal threshold, glucose begins to appear in urine.

Complications of the small blood vessels are specific to diabetes. Hyperlipidemia is another major problem. It has been estimated that frequency of elevated lipid levels in diabetes is 40 to 90%. As a result, diabetics experience 2-3 fold increase in cardiovascular morbidity and mortality when compared to nondiabetics. Preventive measures against diabetes should therefore aim at lowering of serum cholesterol and triglyceride levels. The risk of small blood vessel complications specific to diabetes as well as large blood vessel disease should also be reduced.

Lacunae in conventional treatment of diabetes mellitus

Although euglycemia can be achieved in diabetic patients by conventional insulin and oral glycemic drug treatment, microvascular and neurologic complications are not averted. Insulin has also been reported to increase cholesterol synthesis and secretion of very low density lipoproteins. Adherence to carbohydrate restricted diets also leads to the development of insulin resistance and serum cholesterol levels are raised in diabetic patients.

Persons with diabetes mellitus may reap substantial benefits from increasing their intake of dietary fiber. Epidemiological studies have shown that prevalence of diabetes is lower in population with high fiber intakes than in Westernized population with low fiber intakes. In regions such as Japan, India and the West Indies, where intake of dietary fiber is high, the specific complications of diabetes are less frequent than in Western countries where the fiber intake is low. Heart attacks and diabetic gangrene among persons with diabetes are less common in India and Japan than in the USA.

Clinical Studies

Two approaches have been followed to study the effect of dietary fiber on glucose metabolism in diabetes.

(a) Use of fiber supplemented diets : Jenkins and colleagues added highly purified products such as guar gum to the usual diets of diabetics and documented a 50% reduction in glycaemia. They also developed a crisp bread preparation. When patients consumed 14 to 25 g/day of guar in this form, they required less insulin. Serum lipids of the patients were also lowered. Prolonged beneficial effect of guar specifically has not been confirmed, although some workers have demonstrated long term improvement in glucose tolerance and metabolism with fiber-supplemented diets. Moreover guar has very limited palatability.

(b) Use of fiber rich foods : Better control and reduced insulin and sulfonylurea requirement in both mild and moderate diabetes have been reported by the inclusion of commonly available foods rich in dietary fiber in the diet. In some cases improvement in lipid profile was also observed. In repeat experiments however, such diets did little to improve the levels of blood glucose, insulin or blood lipids. Patient drop-out rate was very high indicating the unsuitability of this approach as a long term measure.

Fenugreek as fiber food

Fenugreek (Trigonella foenum graecum) is a leguminous herb (Sanskrit-Mathika ; Hindi-Methi; Gujrati-Methi; Telugu-Menthi Koora; Malayalam-Uluba). It is commonly cultivated as condiment in India and North African countries. The dwarf type is grown for culinary purposes and the tall growing one for fodder. The seeds are yellow in colour and bitter to taste. Known for a long time for their medicinal qualities, fenugreek seeds have been mentioned in Greek and Latin pharmacopoea and Ayurvedic literature. Treatment with a decoction of fenugreek seeds has been reported by several workers to improve diabetes and suppress glycosuria in mild diabetes and bringing about improvement in severe diabetic condition (Loeper, Baver and Zahnd, Miskinsky and Ghafghazi et al.). Unfortunately in those days, diagnostic criteria for diabetes were vague and primitive. Diabetes was diagnosed by taste of urine. Classical laboratory tests for urine and blood and other sophisticated diagnostic parameters were unknown.

Fenugreek contains mucilaginous fiber and total fiber to the extent of 20% and 50% respectively. It also contains trigonelline, an alkaloid known to have an effect on glycosuria. This has prompted us to conduct many controlled trials in man and experimental animals aimed at studying the blood glucose lowering effect of fenugreek. As hypercholesterolemia and atherosclerosis are the natural sequelae of diabetes, studies were extended to find out the effect of fenugreek on raised levels of serum cholesterol.

Hypocholesterolemic activity of fenugreek seeds

When rats fed on cholesterol-raising diet were given fenugreek at 60%, 30% and 15% levels, the elevation of serum cholesterol was prevented. LDL + VLDL cholesterol was lowered. HDL cholesterol and triglycerides were not affected. Ratio of HDL cholesterol to total cholesterol was significantly increased ($P < 0.01$). Thus fenugreek has a cholesterol-lowering effect on exogenous cholesterol only but not on endogenous cholesterol (Table-1). Among the various components of fenugreek tested for hypocholesterolemic property, only the fiber and saponin components of the seeds exhibited cholesterol-lowering activity. High levels of serum cholesterol in man were also lowered.

Table - 1.

SERUM AND LIVER LIPIDS IN CONTROL AND FENUGREEK FED GROUPS OF RATS

	Serum lipids (mg/dl)				Liver lipids (mg/g)		
	Total cholesterol	HDL cholesterol	LDL cholesterol	Triglycerides	Total lipids	Cholesterol	Triglycerides
I Control	242@ ± 30	52 ± 6	259 ± 32	63 ± 5	22.6 ± 0.8	10.8 ± 0.45	5.58 ± 0.74
II Fenugreek	105 ± 4 ***	62 ± 5	43 ± 4 ***	60 ± 3.7	9.5 ± 0.56 ***	2.58 ± 0.30 ***	3.7 ± 1.07

@ Mean ± SE
Significantly different from Group I : *** $P < 0.001$

Fenugreek was shown to bring about the hypocholesterolemic effect through increased excretion of faecal bile acids and neutral sterols; Depletion of cholesterol stores in the liver was also involved. Scientists at the CFTRI, Mysore, showed that dietary fenugreek had the property of stimulating bile formation in the liver and also of converting cholesterol into bile salts. Our observations on fenugreek have been confirmed by researchers from various parts of the world. It may be pointed out that hypocholesterolemic activity of fenugreek is much more than that shown by other legumes such as Bengalgram, blackgram and soyabean. Changes in lipid levels produced by fenugreek administration represent a protective mechanism against the development of atherosclerosis and coronary heart disease.

Hypoglycaemic effect of fenugreek

The hypoglycaemic effect of fenugreek seeds (25 g) and leaves (150 g) was tested in normal subjects. Whole fenugreek seeds, defatted fenugreek seeds, gum isolate of fenugreek seeds, cooked fenugreek seeds and cooked fenugreek leaves were administered to healthy subjects and their effect in preventing the rise in plasma glucose after a dose of glucose (100 g) or after a meal was determined. Rise in plasma glucose was prevented by ingestion of fenugreek seeds. Serum insulin levels were also modified to a similar extent. The observed effect was highest with whole seeds. This was followed by gum isolate, extracted seed and cooked seeds in that order. But

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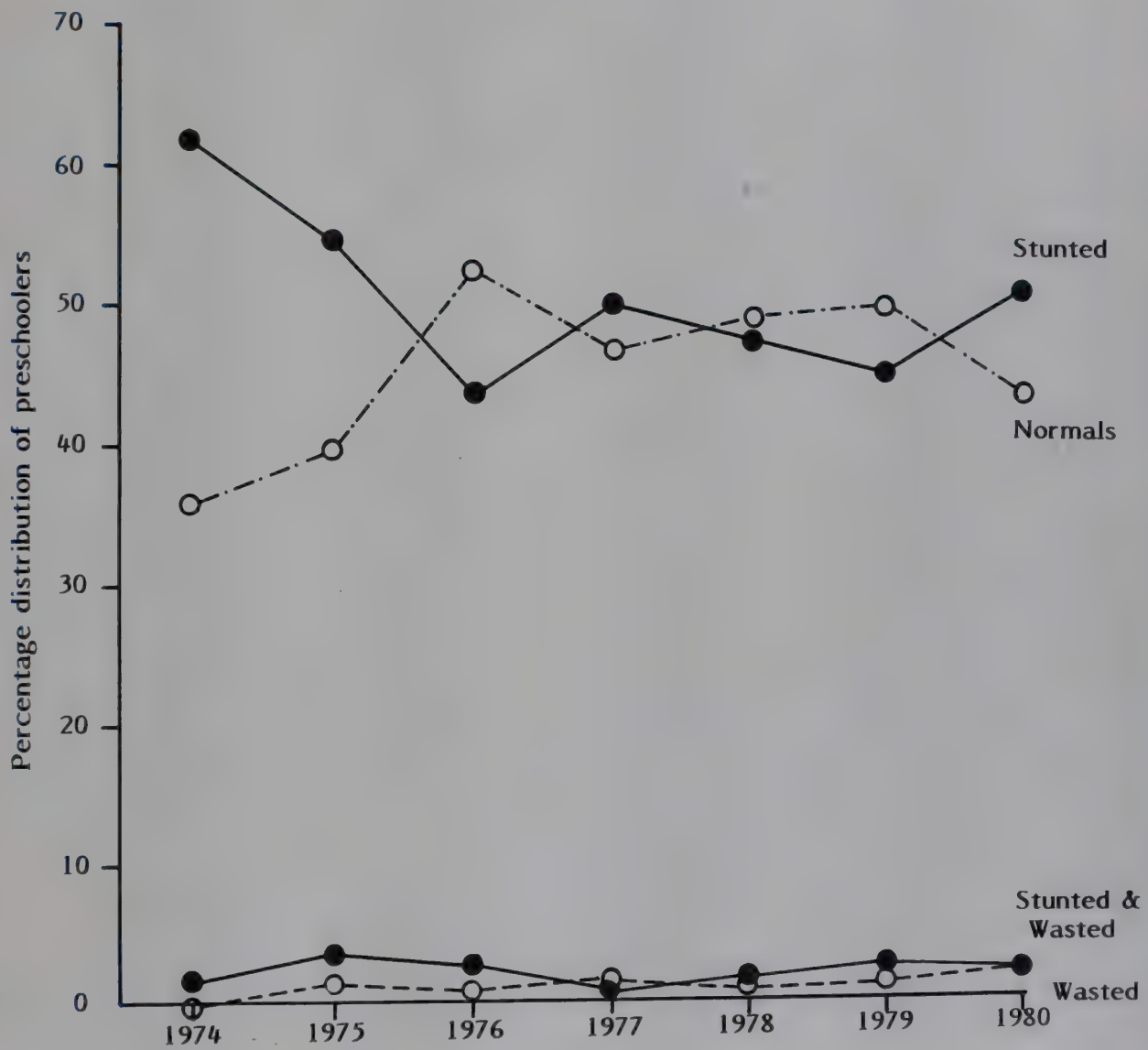
DISTRIBUTION OF RURAL CHILDLREN (1-5 years) ACCORDING TO 'STUNTING' AND 'WASTING' CLASSIFICATION (WATERLOW) TIME TRENDS IN KARNATAKA

(Source : NNMB Surveys)

BOYS



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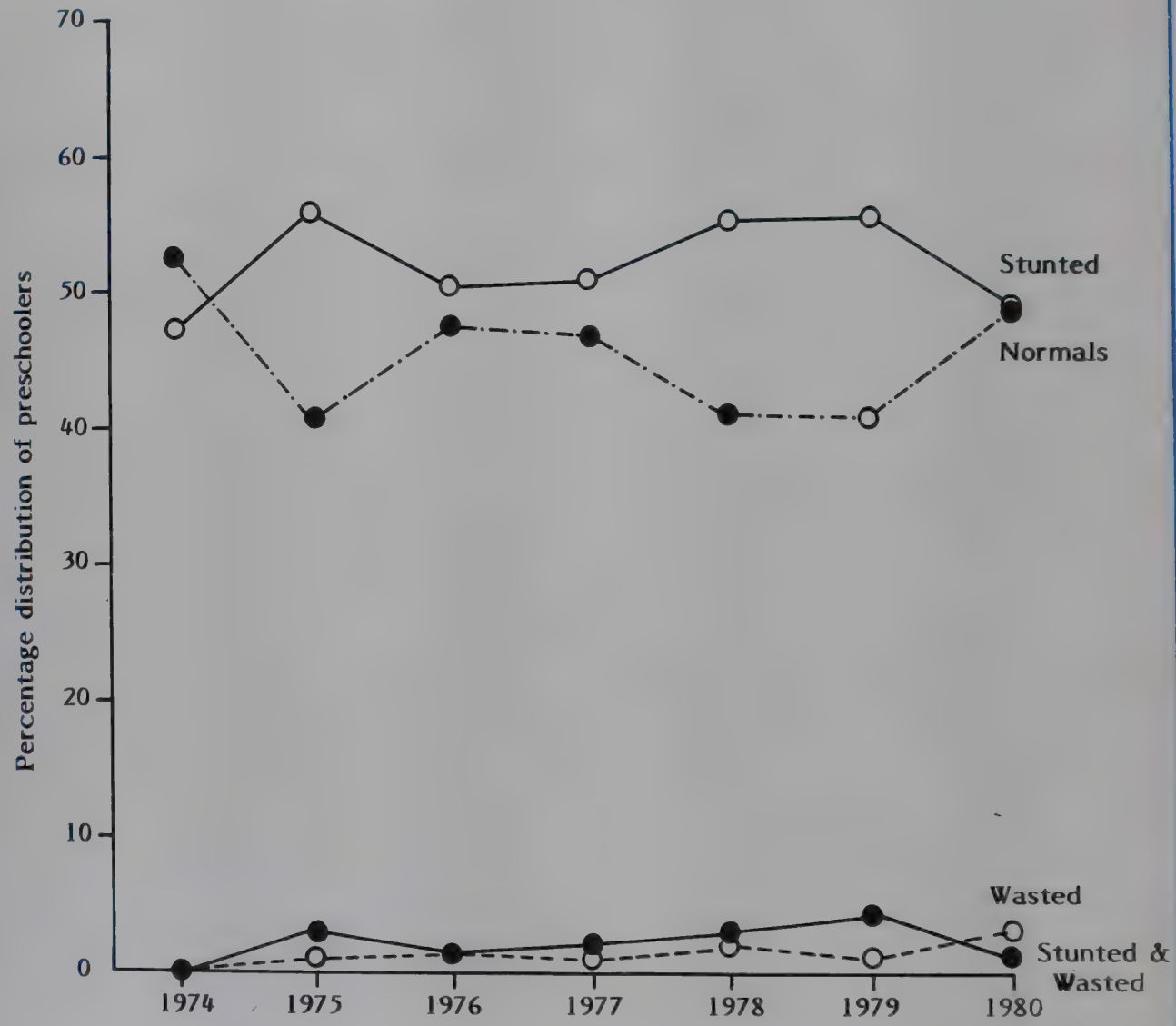

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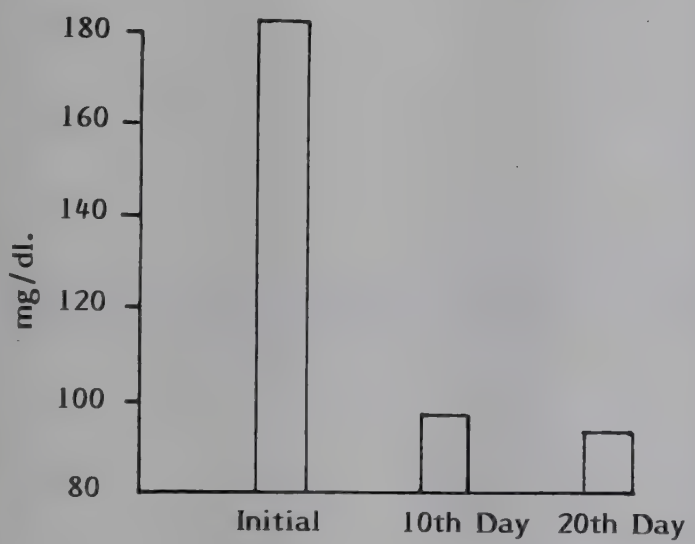
This study indicated that fenugreek has blood glucose lowering property. This activity is because of the gum present in the seeds which is not lost during the cooking process.

A comparison was made on the effects of adding equivalent amounts of fenugreek seeds, guar, tragacanth, pectin, methyl cellulose, wheat bran and cholestyramine, on post-prandial glucose and insulin response to glucose load. Fibers in the first three substances showed similar effects while the remaining ones showed a lower effect on glycaemia.

The effect of dose and form of fenugreek on the magnitude of reduction in blood glucose and insulin levels were also studied. When 25 g. of fenugreek was added to chapati or dhal, the effect on serum glucose and insulin response was similar. 50 g. of fenugreek produced better effect than 25 g. of fenugreek. Fenugreek given in the form of a drink 15 min. before the meal, demonstrated a significantly higher effect on blood glucose response than fenugreek given along with the food.

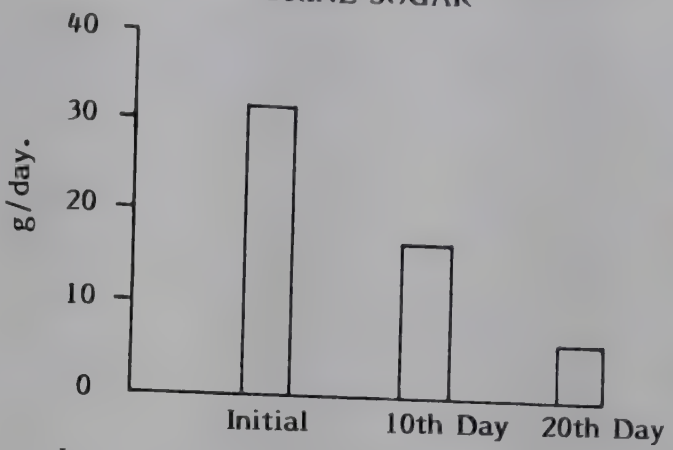
Fig. 1
EFFECT OF FENUGREEK IN DIABETES
BLOOD SUGAR



Hypoglycaemic and hypolipidemic effect of fenugreek seeds in diabetics

When fenugreek seeds (25 g.) were administered to diabetics for 21 days, a significant improvement in plasma glucose response was observed. Insulin levels were reduced. Twenty four hours urinary glucose output and serum cholesterol levels were significantly reduced. Diabetic symptoms like polyurea, polydipsia and polyphagia were found to be under control. Further, in two insulin-dependent diabetic subjects, daily adminstration of 25 g. fenugreek seed powder significantly improved both plasma glucose profile as well as glycosuria. Their insulin requirement was also reduced from 56 units/day to 20 units/day after 8 weeks of treatment.

Fig. 2
EFFECT OF FENUGREEK IN DIABETES
URINE SUGAR



In a metabolic experiment, control diet was fed for ten days to non-insulin-dependent diabetics. Then fenugreek (100 g.) was divided into two equal doses and given along with lunch and dinner. Tests in blood and urine were repeated after feeding fenugreek in this manner for ten days.

In a long term trial, 100 g. fenugreek was fed to both non-insulin-dependent and insulin-dependent diabetics. Fasting blood glucose levels were reduced after fenugreek ingestion. Twenty four hour urinary glucose output, serum cholesterol and triglyceride levels were also significantly reduced (Figures 1 and 2). Clinical symptoms of diabetes mellitus were remarkably under control. Two patients complained of excessive gas formation which however disappeared by itself after a few days.

Conclusions :

Fenugreek seeds, a common condiment used in Indian homes were found to diminish reactive hyperglycaemia in normal individuals and those with diabetes. Fasting blood glucose, 24 hour urinary sugar excretion, serum cholesterol and triglyceride levels in diabetics were also significantly reduced. Clinical symptoms like polyurea, polyphagia and polydipsia, present in some cases of diabetes were improved. These effects of fenugreek seem to be due to the gum fiber present in it. It has been possible to debitterize fenugreek seeds without compromising on their hypocholesterolemic and hypoglycemic properties. Debitterized seeds are rich in protein and lysine. Since fenugreek seeds, like pulses, are also a source of protein, they can replace pulses in the diets of diabetics.

Fenugreek can be made into soup, curry and candy. It can be incorporated into bread or chapati. Fenugreek included in daily diet in amounts of 25-100 g. can be effective supportive therapy in the management of diabetes.

Dr. R. D. Sharma

RESEARCH NOTES

Ampicillin absorption

Ampicillin is a commonly used antibiotic in our population. It is administered to control respiratory, urinary and other infections. Absorption of ampicillin is known to be decreased by food and it is also known that ampicillin absorption on empty stomach varies considerably.

In a study to quantitate ampicillin absorption in undernourished subjects, ampicillin (500 mg) was given by I.V. route to 21 individuals. The urinary elimination in 48 hours was measured. The I.V. administration was followed after the period of 1 week by oral administration of 500 mg of ampicillin capsule on empty stomach and urine was collected for 48 hours. The bioavailability or the percentage of absorption was calculated from the urinary excretion data.

The urinary excretion of I.V. administration was found to be almost comparable in both the groups and almost 80-90% of the drug was eliminated within a period of 48 hours. However when ampicillin was given orally, there was a decreased elimination in undernourished subjects. The ampicillin absorption calculated was found to be significantly different between two groups, the well nourished having a higher absorption (50.5%) than the undernourished subjects (38.6%).

The results indicate that ampicillin absorption decreases in undernourished subjects and it is possible that therapeutic failure can occur due to inadequate plasma levels. Further investigations into the plasma levels of ampicillin in these two groups of subjects are underway.

Riboflavin deficiency and Lens glutathione metabolism

A significant increase in high-molecular-weight proteins was reported in soluble fraction of the lens homogenate from riboflavin-deficient rats compared to riboflavin-supplemented rats. In the present investigation we measured the content of both oxidized and reduced glutathione, free and total sulfhydryl groups and the activities of enzymes involved in the redox cycle of glutathione in riboflavin-deficient rat lens. Feeding a diet deficient in riboflavin to rats resulted in significantly decreased glutathione reductase activity and significantly increased glutathione peroxidase activity, as well as, increased ratio of glutathione peroxide to glutathione reductase activities in lens. However, riboflavin deficiency had no effect on either glutathione and sulfhydryl levels or glucose 6-phosphate dehydrogenase activity in the lens. It is concluded that the increased accumulation of high molecular weight proteins observed in our previous study in riboflavin deficiency rat lens is not due to changes in glutathione and sulfhydryl content of the lens. It is highly probable that the increased glutathione peroxidase activity noted during riboflavin deficiency in the present study would indicate increased production of peroxide which is responsible for increased lens protein aggregation in riboflavin deficiency.

TRAINING PROGRAMMES

The Twentieth Master of Science (Applied Nutrition) Course will be held between 1st June 1987 and 29th February 1988. Nine candidates are expected to participate in this course. Of these, two are from Afghanistan, one each from Bangla Desh, Democratic Republic of Yemen and Sri Lanka, and four from various States of India.

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NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL. 8 NO. 4 JULY 1987

CURRENT TOPIC

MUTAGENS AND ANTIMUTAGENS IN FOODS

Introduction

Early in 20th century, a Dutch Botanist named Hugo De Vries noted sudden, heritable, unusual changes in an otherwise fairly uniform population of a certain species of plant, for which he coined the word mutation. These changes were found to take place during cell division. Substances which can cause mutation are known as "mutagens". Risk of cancer is greater on exposure to these mutagens There has been increasing awareness that exposure to environmental pollution due to indiscriminate use of a wide range of chemicals in agriculture and industrial pollutants can lead to genetic damage. The study of this science is known as genetic toxicology. Screening for mutagens in our environment like food we eat, industrial effluents and sewage helps us to assess the risk to the health of the population and take appropriate measures to contain these toxicants in our environment. Several standard chemical methods are available for evaluating mutagens.

Mutagens in foods

Food is a complex commodity on which humans depend for their existence. Wyander (1975) estimated that 50% of cancer deaths in women and 30% in men are due to toxicants and natural chemicals present in our foods. Doll (1981) had estimated that 35% of cancer deaths are due to food toxicants. Hence it is very important to evaluate the hazards caused by various environmental agents and try to eliminate them.

The chemical components of foods are altered prior to ingestion, by processing like cooking or by storage or by the addition of certain food additives. The major components of foods which are known mutagens are indicated below :

Classes of Mutagens in Foods

Natural food constituents	Food contaminants	Food additives	Mutagens generated by food processing	Mutagens generated by storage of foods
Flavonoids	Pesticides	Food colours	Products of heating	Malonaldehyde
Furans	Package materials Solvents	Food flavours Preservatives Sweeteners	smoking broiling curing	Fumigation products Mycotoxins
Alkaloids	Nitroso compounds Polycyclic aromatic hydrocarbons	Anti oxidants Miscellaneous food additives	Irradiation solvent extraction	

Cereals, pulses, vegetables and fruits are natural foods which are rich in a number of chemical compounds like flavonoids, alkaloids and furans. Some of these compounds are known mutagens. Lot of pesticides are used as post-harvest preservation of food commodities as for e.g., grapes are sprayed with suitable pesticide from being attacked by pests. Pesticides include herbicides, fungicides, nematodes, etc. These substances are toxic at certain levels and the suitable cleaning procedures should be followed before using such foods. Similarly, materials used for packaging foods like milk, oil can react with the material if they are acidic or the package material can ooze into the food and contaminate it. Nitroso compounds and polycyclic aromatic hydrocarbons can be formed in foods by heating, smoking, curing the meat with nitrates and similar processes where high temperature in free air to facilitate oxidation are carried out. These processes like heating, boiling, deep fat frying, smoking, broiling, curing, irradiation of foods and solvent extraction of oils are the normal processes where these changes can take place resulting in the formation of mutagens.

We use lot of food additives like food colours in jams, marmalades, squashes, ice creams and sweets for aesthetic reasons. There are some permitted food additives which have been tested for their safety. Some of the food colours in small quantities also can be mutagenic. Food flavours are also used similarly in food and more in paediatric drugs. Preservatives are used to prevent fungal growth and bacterial attack in the above food preparations. Artificial sweeteners like saccharin are used in many of the above preparations. Anti-oxidants are used in many preparations to prevent oxidation at high temperatures. The types of these chemical additives and the level of their usage have to be chosen with great care. Due to improper storage conditions certain type of fungus can grow over many cereals, oilseeds and other food materials. The fungal metabolites are quite toxic and they can cause health hazards if they enter the food chain. So a great care has to be taken to avoid these compounds in foods beyond their permitted limits.

Allthough many Carcinogens have been identified in the diet, only naturally occurring contaminants have been causally associated with cancer in humans. It has been clearly demonstrated that Carcinogenic N-Nitroso compounds may be formed within the body from non-carcinogenic precursors present in the diet.

Screening methods

The use of laboratory animals for assessing the mutagenic and carcinogenic effects of these many thousands of compounds in the diet is not practical. Hence chemical screening methods are resorted to, to assess the toxicity of a compound which can be further tested by detailed study. The principles and the guidelines of these assays are described below.

We in our Institute have initiated screening of processed foods for the mutagens by the standard methods. The processed foods were extracted and fractionated into various fractions and the assays were carried out. Deep fat frying of foods is a common practice all over the world. As this involves exposure to high temperature in free air, oxidation and polymerisation of the fat is facilitated and various derivatives are formed. There is always a doubt about the safety of reuse of repeatedly heated oil and foods fried in them. The commonly used oils like groundnut oil, coconut oil, gingelly oil were used to fry potato finger chips. After repeated frying, the oil and the chips were tested for mutagenecity but no mutagenicity could be demonstrated. None of the oils even after 24 hours heating showed any mutagenecity indicating that they are safe for human consumption. Unconventional oils are undergoing food safety evaluation in these laboratories. Mutagenicity is a part of food safety evaluation and hence unconventional oils like mango kernel oil, neem oil, cleome viscosa oil, mesta oil, cashew nut shell oil, kapok oil and mahua oil were screened for mutagens. Out of the seven oils only mesta oil (Hibiscus sabdariffa oil) and cashew nut shell oil showed mutagenicity which was further confirmed by other toxicological studies. None of the other oils showed any mutagenicity. Similarly, rice bran oil as a new cooking medium is slowly catching up. Several commonly used deep fat fried foods were prepared using rice bran oil and evaluated for mutagenicity. None of the foods tested showed any mutagenicity.

Antimutagens in foods

Food contains some chemical components which have neither any nutritional property nor any role in normal metabolic processes. These components are generally removed in the process of refining. These compounds are generally fibre, polyphenols (which impart colour) saponins, lectins, tannins, coumarins, amines, flavonoids and anthocyanins. Recent studies revealed that most of these compounds have some beneficial effects like reducing blood cholesterol and triglycerides and other useful properties like antidiabetic, antifertility, anticarcinogenic, anti-allergic, antimutagenic effects. Wattenberg (1983) reported that foods contain large number of anticarcinogens and antimutagens, i.e. these compounds counteract the effect of carcinogens. The compounds are polyphenols, aromatic isothiocyanates, methylated flavonoids, coumarins, plant sterols, selenium salts, protease inhibitors ascorbic acid, tocopherols and retinols which are known to inhibit cancer formation. Epidemiological studies showed that vegetarians have lower risk of cancer than the non-vegetarians as green coloured raw vegetables have most of the above compounds. Wattenberg suggested that these compounds can reduce the risk of cancer.

Several screening methods are available to identify the antimutagenic factors in

DISTRIBUTION OF RURAL CHILDREN (1-5 years) ACCORDING TO 'STUNTING' AND 'WASTING' CLASSIFICATION (WATERLOW) IN KERALA DURING THE PERIOD 1974 - 80

(Source : NNMB Surveys)

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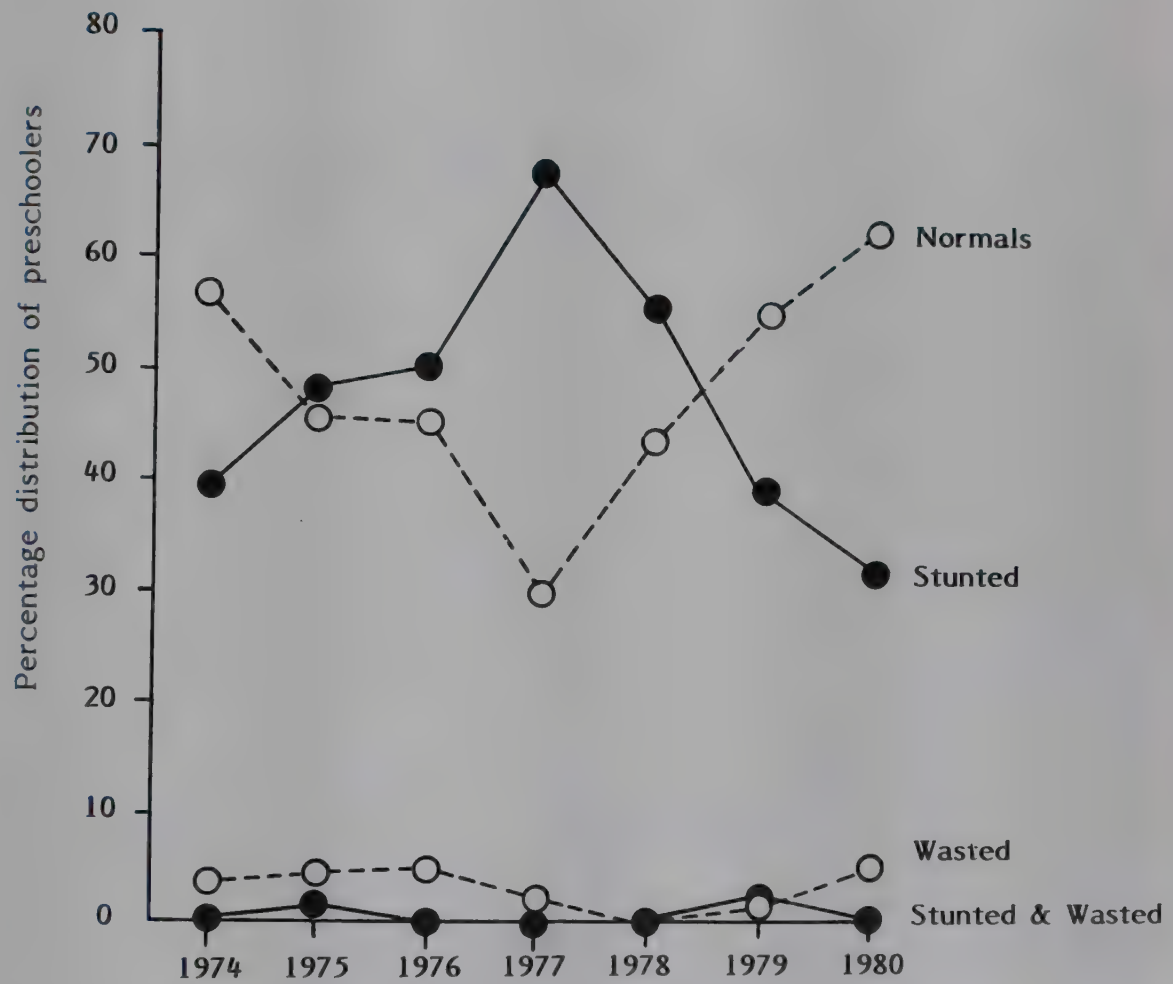

Median Values of Heights and Weights of Well-to-do Indian children are used as standards.

'Stunting' : Children having height for age less than 90% of standard value.

'Wasting' : Children having weight for height less than 80% of standard value.

'Normals' : Children who did not exhibit 'stunting' or 'wasting'.

UNIT

DISTRIBUTION OF RURAL CHILDREN (1-5 years) ACCORDING TO 'STUNTING' AND 'WASTING' CLASSIFICATION (WATERLOW) IN KERALA DURING THE PERIOD 1974-80

(Source : NNMB Surveys)

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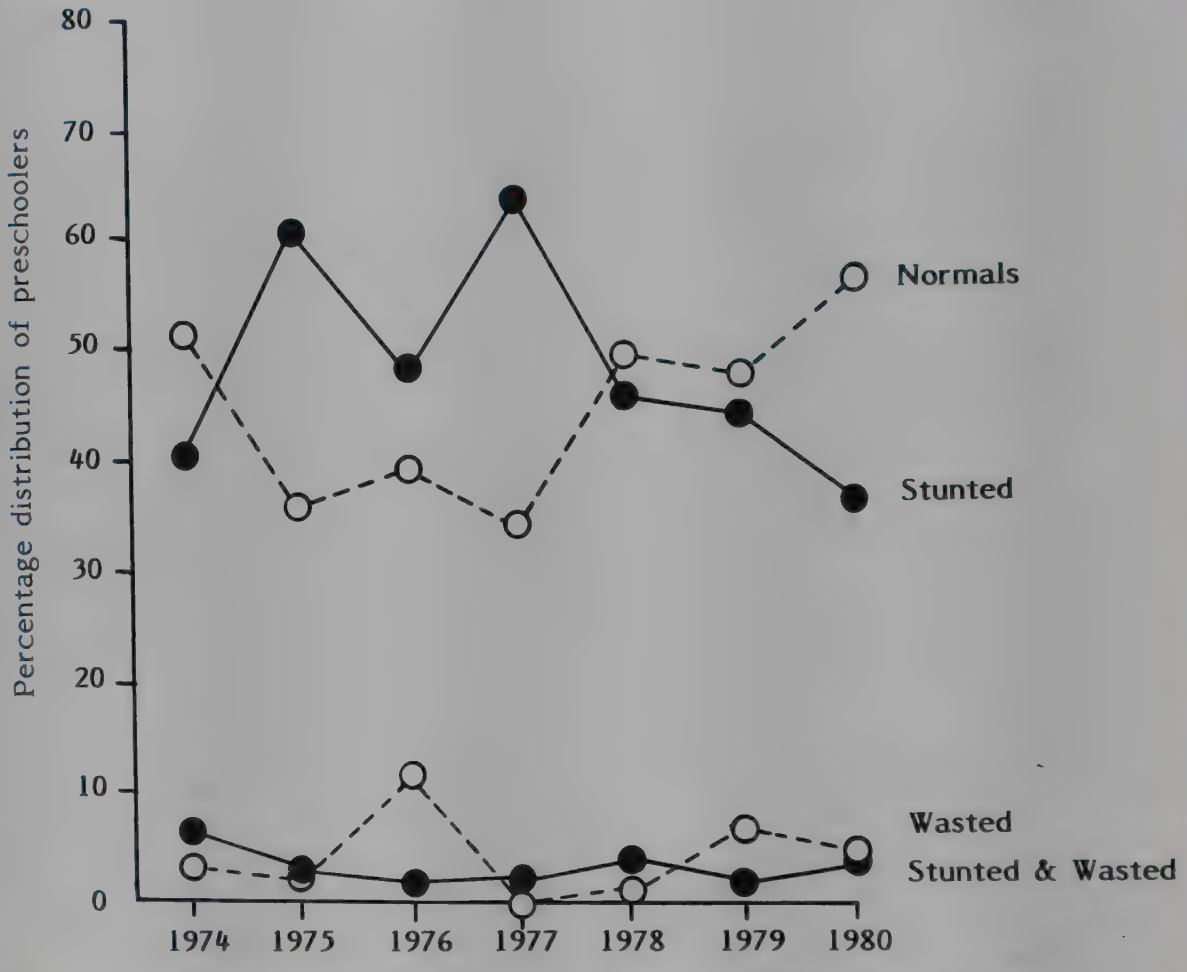

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the bacterial assay is modified for antimutagenecity assay. A carcinogen is introduced in the system along with the antimutagen and the inhibitory effect is measured. This modified Ame's test is used for chemical screening of antimutagens in the diet.

It is very difficult to assess the significance of these results, obtained by the bacterial mutagen, to man. But food processing involves high temperature, oxidation, polymerisation and production of nitrosamines, polycyclic aromatic hydrocarbons, etc. which are injurious to health. These tests can be used to screen such foods to detect the presence of carcinogens. Foods suspected to contain mutagens and carcinogens need to be studied further in detail to establish their safety for human consumption.

- Dr. C. Rukmini

RESEARCH NOTES

Iodine content of commonly consumed foods

Iodine is an important trace element whose deficiency in food and water leads to iodine deficiency disorders including goitre.

An analysis of commonly consumed vegetables, greens, spices and beverages revealed that green leafy vegetables have relatively higher concentrations of iodine whereas fruits like apple and sweet lime have almost negligible amounts of iodine.

Among pulses like lentil, bengal gram, green gram, red gram, black gram and horse gram, the iodine content of horse gram was the highest (58 µg/kg) and that of red gram was the lowest (30 µg/kg). Among millets Panicum miliaceum had the highest iodine content (61 µg/kg) while Panicum miliare and Echinochloa had the lowest (25 µg/kg).

After decortication, lentil had the highest amount of iodine (45 µg/kg) and contributed about 97.8% to the whole grain iodine. Other decorticated pulses (dhals) contained about 82-84% of the whole grain iodine. Varietal differences were not significant for the whole grain or for the 'dhals' analysed.

The effect of malting on iodine content of millets revealed that malting resulted in a loss of iodine in all the millet varieties studied. This loss of iodine varied for the different varieties, the higher loss being seen in Setaria italica and the lowest in Paspalum scrobiculatum. Parboiling on the other hand did not cause any significant loss in iodine content of any of the millets. In this regard, these millets resemble rice in which no loss was observed in minerals after parboiling.

Nutritional anthropometry of Indian adults

Nutritional anthropometric study was conducted on adults in urban and rural areas of Hyderabad. Height, weight, arm circumference and fat fold at triceps were taken on all adults. Mean values of measurements and indices - weight for height (%) weight/-height, weight/height^2 and weight/height^3 were compared between adults by age, sex and socio-economic status. Though height was more or less same by age ($P < 0.05$) measurements of weight, arm circumference, fat fold at triceps and indices were found to vary by age ($P < 0.05$) in males and females. Mean values of measurements and indices were higher in adults of upper middle socio-economic group than those of lower socio-economic group. Of all the indices, weight for height (%) and weight/height^2 did not correlate with height, indicating that shorter and taller people could have the same value for these indices, but correlated well with weight, arm circumference and fat fold at triceps.

Correlation coefficient between weight for height (%) and weight/height^2 was closer to 1.00. Feasibility of these indices for assessing the degree of undernutrition and overnutrition compared to weight/height and weight/-height^3 are discussed. Prevalence rates of undernutrition and overnutrition were found to vary by age, sex and socio-economic status.

TRAINING PROGRAMMES

The Sixteenth Annual Certificate Course in Endocrinological Techniques and their Application will be held between 3rd August and 18th September 1987. Teachers in Medical colleges working in the departments of general medicine, paediatrics, obstetrics and gynaecology, pharmacology, physiology and biochemistry, scientists in research institutes and university departments and biochemists working in large hospitals with clinical laboratory facilities are eligible for this course. Seven participants, one each from Andhra Pradesh, Karnataka, Maharashtra, Punjab, Rajasthan, West Bengal and Defence Services are expected to participate in the course.

Readers may please note that in the article on "Diabetes mellitus and fenugreek seeds" (current topic, Nutrition News, Vol..8 No.3, May 1987) by Dr. R.D. Sharma, the investigations reported on p.3. on long term trial among diabetics were carried out in collaboration with Dr. T.C. Raghuram of the Drug Toxicology section, NIN.

EXPLANATORY NOTE

Use of Fenugreek seeds (Trigonelle foenum graecum) by diabetics :

A write-up based on the studies carried out at National Institute of Nutrition regarding beneficial effects of fenugreek (methi) seeds in diabetes mellitus had appeared in the May 1987 issue of this Newsletter. The report has generated great public interest to know more details about this "bitter but beneficial" approach to diabetes control. There have been numerous letters raising common questions. We are therefore reaching you again through this column to present more information about methi, the dose, duration, mode of its usage as well as some do's and dont's of this dietary supportive measure in the treatment of diabetes.

1. Seeds of fenugreek (methi) are commonly used as a condiment for seasoning food preparations. They are available in any grocery shop.
2. Studies among diabetics have shown that use of fenugreek seeds has a beneficial effect reducing glucose levels in blood and urine. Fenugreek leaves (methi sag, commonly used as a green leafy vegetable) do not show any such effect.
3. The quantity of fenugreek seeds to be taken daily depends upon the severity of diabetes. The doses vary from 25 g. to 100 g.
4. To begin with 25 g fenugreek seeds may be taken in two equal doses of 12.5 g each (approximately one table spoon) along with lunch and dinner. They can be added to chapati, rice, dhal, vegetable or chutney and made salty or sour according to taste.
5. The seeds can be taken as such or in a powdered form as a drink in water or in butter milk 15 mts before the meal.
6. Fenugreek seeds are only useful as support therapy and normal treatment used can be continued. It has been observed that diabetic drug requirement decreases with the use of fenugreek. Optimal dose adjustment can be achieved under the advice of a physician.
7. Fenugreek can be taken by diabetic patients as long as high blood sugar or urine sugar levels persist.
8. The dietary calorie consumption should be restricted and body weight should not be allowed to increase. The effect is dramatic when fenugreek is consumed with 1200-1400 Kcals diet per day, which is usually recommended for diabetics.
9. Avoid sugar as usual.

The above information is based on the research work carried out among some cases of diabetics. This approach may be followed in individual cases only in consultation with their attending physician.

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NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL. 8 NO. 5 SEPTEMBER 1987

CURRENT TOPIC

NUTRITIONAL IMPLICATIONS OF MILLETS AND PSEUDOCEREALS

Cereals and millets constitute a major component of diets consumed in India. They contribute to 70-80% of calorie intake and a significant proportion of several other nutrients except vitamins A and D. Production and per capita availability of fine and coarse grains are given in Table - 1. Of the total staples available in the country, about 75% is contributed by rice and wheat and the remaining by coarse grains. These coarse grains form a significant proportion of daily diets of the poorer segments of the population in rural and tribal areas. The fine grains like rice and wheat are grown mostly in the irrigated areas, while the coarse grains are largely cultivated as rain-fed crop on dry land in semi-arid regions of the country.

Table - 1

Current production of cereals and millets and their per capita availability (1983-84)

Grain	Annual production (million tons)	Per capita production (g/day)	Net availability (g/day)
Rice	59.8	222	194
Wheat	45.2	168	147
Millets*	33.9	126	110
Total	138.9	516	451

*Jowar - 11.9 ; Maize - 7.9 ; Bajra - 7.6 ; Others - 6.5 ;

While there has been a spectacular increase in the production of rice and wheat, coarse grain production has been either stationary or has actually decreased. Reflecting these production trends, consumption of coarse grains also is known to have decreased.

Coarse grains or millets like jowar, maize bajra, ragi, italian millet etc., have poor consumer appeal and are considered as poor man's food. Although rich in several nutrients (particularly minerals), these millet grains have a thick coat and fairly high fibre content (Table - 2). The quality of these grains can however be upgraded by suitable processing techniques like pearling and wet milling, which reduce their fibre content. Malting

Table - 2.

Nutrient composition of millets (per 100g edible portion)

Grain	Protein (g)	Total fat (g)	Crude fibre (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Copper (mg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)
Bajra	11.6	7.1	1.2	42	5.0	3.1	1.06	0.33	0.25	2.3
Italian millet	12.3	4.3	8.2	31	12.9	2.4	1.40	0.59	0.11	3.2
Jowar	10.4	3.2	1.6	25	5.8	1.6	0.46	0.20	0.18	2.3
Maize	11.4	6.3	2.7	10	2.0	2.8	0.41	0.42	0.10	1.8
Ragi	7.3	3.1	3.6	344	6.4	2.3	0.47	0.42	0.19	1.1
Rice	6.4	3.1	1.0	10	3.1	1.4	0.17	0.21	0.16	3.9
Wheat	11.8	3.0	1.2	41	4.9	2.7	0.68	0.45	0.17	5.5

can improve not only the nutritive quality of millets but also their flavour. The Central Food Technological Research Institute (CFTRI), Mysore has developed from millets several weaning foods and snack foods with high consumer acceptance. These millets are rich in trace minerals and the National Institute of Nutrition has systematically evaluated the bioavailability of these trace minerals. The effects of processing like malting and pearling of millets on the trace mineral content and bioavailability were also studied. Although the trace elements content decreases marginally as a result of such processing, their bioavailability was found to be significantly increased.

MILLETS

The important features of some most commonly used millets with particular reference to their nutritional quality are given below:

1. Ragi: Ragi is a staple used in parts of Karnataka, Andhra Pradesh and Tamil Nadu. It is the richest source of calcium next only to milk. Brown ragi has a high content of tannin and phytate which reduce bioavailability of trace minerals like iron and zinc. Malting improves the nutritional quality of ragi considerably; the starch gets

partially hydrolyzed and becomes easily digestible and can therefore be used as weaning food. Mineral availability is also enhanced by malting. Consumer appeal of ragi can be improved by reduction of its dark outer coat brought about by pearling.

There have been successful attempts to breed white coloured ragi, to improve its consumer acceptance. Work carried out at the National Institute of Nutrition indicates that white ragi is similar to the traditional brown ragi in nutrient content. Moreover, bioavailability of iron and zinc in white ragi is even much better than in brown ragi. This latter quality is primarily due to low content of tannin in white ragi. Weaning foods of high quality can be prepared from malted white ragi. Because of its higher content of minerals like calcium and iron, ragi can serve as a good supplement to rice-based diets by improving the overall mineral content. For example, addition of 50g of ragi a day to the rice based diet of a child can make good dietary calcium deficiency.

2. Jowar : Grown on dry lands in semi-arid areas, Jowar is cultivated on a larger scale than other millets. It is a staple of large numbers of rural people in Karnataka, Maharashtra and Andhra Pradesh. This millet is also a good source of trace minerals. The quality of the grain can be improved by pearling and this process increases mineral availability also. Although jowar has been a staple of the rural poor for a long time, in recent years, its consumption has gone down largely due to easy availability of finer foodgrains like rice. Studies at CFTRI have shown that jowar can readily lend itself for preparation of delicious snack foods of great consumer appeal. Jowar will continue to be a major crop in rain-fed areas.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and Indian Council of Agricultural Research (ICAR) have been successful in identifying high yielding varieties of millet.

3. Bajra : Bajra is grown in large tracts of the country. Several hybrid varieties with high yields have also been introduced. As is the case with other millets, this grain is a rich source of minerals, particularly iron and zinc. It has a high level of fat similar to maize. Bajra can also be malted, resulting in an increase in the availability of minerals like iron and zinc without affecting the total trace mineral content. Germinated bajra can perhaps be used as infant food. However,

its consumer acceptability needs to be improved by suitable processing or through converting it into quality products.

4. Maize : Cultivation of maize has increased considerably in recent years. Apart from being a staple, maize has industrial applications such as production of starch and edible oil. This industrial use of corn has perhaps given an impetus to its production. Maize also can be readily converted into snack and breakfast foods.

5. Other millets : Several other millets are grown in isolated pockets. The common features of all these coarse grains are their high fibre content, high content of trace metals and poor consumer acceptability. They are consumed by rural poor as staples along with other coarse grains. These millets are also grown and widely consumed by tribals.

Increased production and utilisation of millets

Generally speaking, these millets are coarse grains grown on poor soils under rain-fed conditions and have low consumer acceptability. Their yields are low with meagre returns. There is a need to boost and stabilize their production and ensure adequate economic returns to the poor farmers who grow these grains. In this direction, consumer demand for these grains also needs to be built up.

With the joint effort of agriculturists, nutritionists and technologists the production of millets and their demand can be increased. The following strategies may be suggested for this purpose:

1. Maximising and stabilising yields through development of high yielding strains, and management techniques. ICAR and ICRISAT are currently giving attention to these aspects particularly in respect of Sorghum.

2. Development of improved quality grains like white coloured ragi.

3. Reduction of fibre content by suitable processing.

4. Conversion into delicious snacks and value added products.

5. Using some coarse grains as animal feed the protein quality being upgraded by supplementation with defatted oilseed cakes.

PSEUDOCEREALS

The other class of minor grains characte

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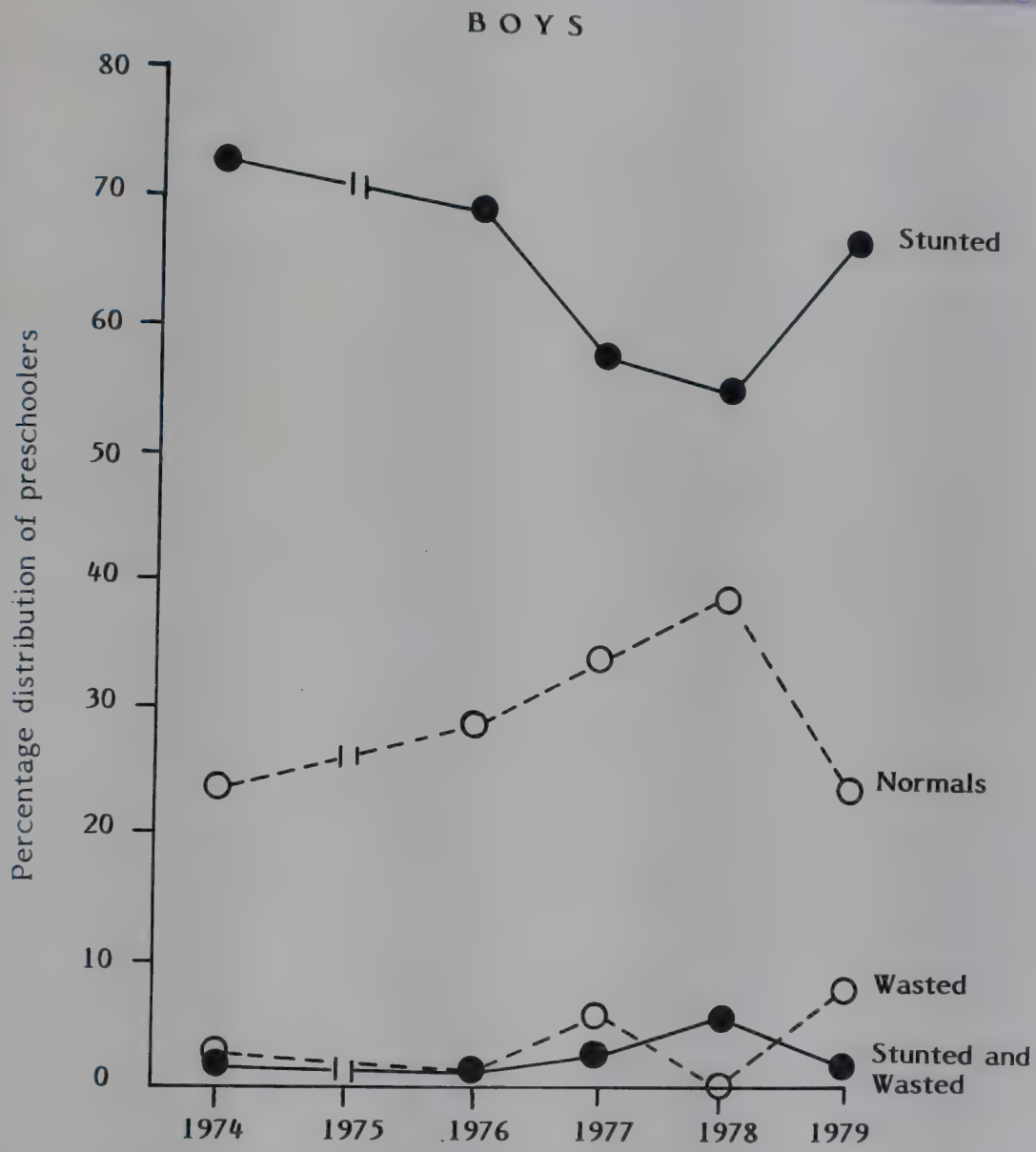
DISTRIBUTION OF RURAL CHILDREN (1-5 YEARS) ACCORDING TO 'STUNTING' AND 'WASTING' CLASSIFICATION (WATERLOW) IN MADHYA PRADESH DURING THE PERIOD 1974-79

(Source : NNMB Surveys)



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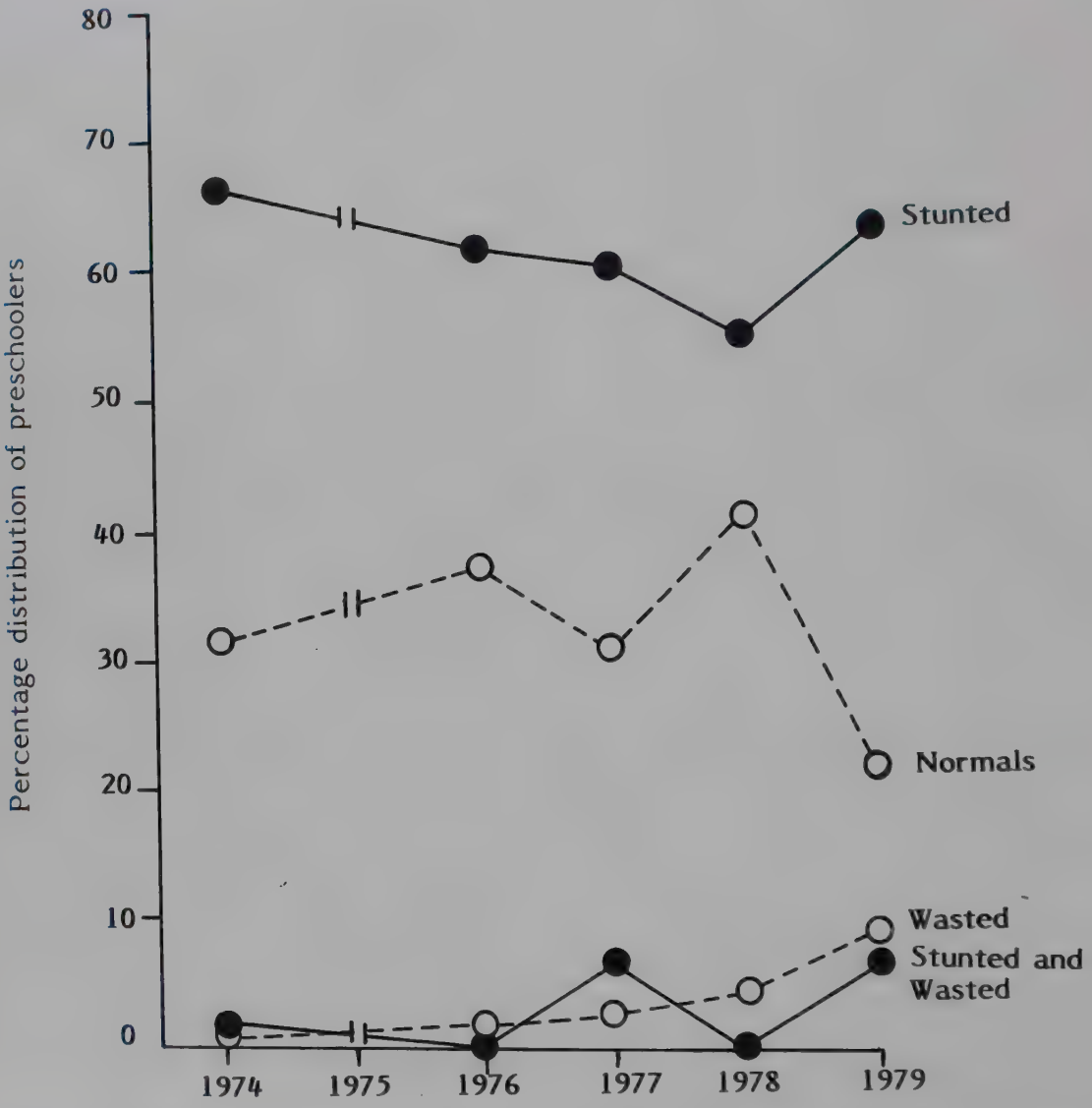
(Source : NNMB Surveys)

GIRLS



Median Values of Heights and Weights of Well-to-do Indian children are used as standards.

'Stunting' : Children having height for age less than 90% of standard value.

'Wasting' : Children having weight for height less than 80% of standard value.

'Normals' : Children who did not exhibit 'Stunting' or 'Wasting'.

sed by high nutritional quality are the pseudocereals. They are mostly grown in isolated pockets of dry lands in hilly tracts and slopes, and consumed predominantly by the tribal population. Several of these known grains which can be classified as pseudocereals have formed part of man's diet from time immemorial. Many such minor grains are grown and consumed in South America. In India too some are cultivated and consumed. Buck wheat, oats, chenopodium and amaranth are grown in Himachal Pradesh and other Sub-Himalayan regions and consumed as a food. They are used as special purpose foods in many parts of India. A good example is grain amaranth (Raj keera) which is consumed during fasting days in many parts of the country. Their production potential and other agronomic details are not much known.

Nutritional composition of the common pseudocereals is given in Table-3. By and large, their nutritive quality is superior as compared to millets or even the finer cereals like rice and wheat. They are richer sources of proteins, minerals and vitamins. Protein (14-17%) and fat (5-6%) contents are also high. One interesting feature of some of these grains is that their proteins have a better amino acid composition with high level of lysine which is deficient in proteins of most of other cereals and millets. For instance, the nutritive value of the proteins like of grain amaranth is comparable to that of casein. Since these pseudocereals have a high protein content of good quality, these grains can serve as a sole source of good quality protein even without supplementing them with pulses or lysine unlike other cereals. Considerable work has been carried out at the National Institute of Nutrition on the nutritive value of some of these pseudocereals, particularly the grain amaranth. One disadvantage of these grains is their high fibre content and small size.

Table - 3

Nutrient composition of pseudocereals

Nutrient	Buck wheat	Job's tear	Oats	Chenopodium	Grain amaranth
Protein (g)	10.3	17.5	13.6	14.4	16.5
Fat (g)	2.4	6.0	7.6	7.3	5.3
Fibre Crude (g)	8.6	0.5	3.5	-	2.7
Calcium (mg)	64.0	23.0	50.0	300.0	223.0
Iron (mg)	15.5	4.2	3.8	5.3	17.6
Thiamine (mg)	0.9	0.31	0.98	0.17	0.17
Riboflavin (mg)	0.34	0.15	0.16	0.17	0.20
Niacin (mg)	4.4	6.70	1.1	3.50	3.60
Lysine* (g/100g protein)	4.8	2.1	3.7	4.1	5.00

*Lysine content (g/100 g protein) of rice and wheat is 3.7 and 2.7 respectively.

Pseudocereals are particularly suited for use as special foods such as weaning foods because of their high nutritive value. Amaranth can be popped and powdered and used as ready-to-feed weaning food. The National Institute of Nutrition is currently exploring the possibility of developing weaning foods with amaranth, after duly processing them to reduce fibre content. The following developmental action is necessary to exploit these high nutritional quality grains.

1. Agronomic characteristics of these pseudocereals particularly grain amaranth are to be studied, with a view to improve their productivity and extend and encourage their cultivation. Development of amaranth with larger grain size will help its better utilization.

2. Due processing techniques must be developed and applied to encourage utilization as special foods particularly for infants and children.

Supplementing effect of millets and pseudocereals on nutrition of cereal based diet

In view of the growing demands for foodgrains in our country where rice and wheat production may reach a plateau, exploitation of millets and pseudocereals as foodgrain may become inevitable. This is particularly so since large tracts of our land are semi-arid where only coarse grains can be grown. Currently these grains are consumed mostly by the poor. But by upgrading their quality, these grains can be accepted and consumed by the higher income groups also. Pseudocereals which have a fairly high protein content of good quality and being rich in lysine may be used to supplement cereals thereby upgrading the overall protein quality of the diet.

- Dr. B. S. Narasinga Rao

RESEARCH NOTES

STEADY-STATE LEVELS OF PHENYTOIN

Phenytoin or dialautin sodium is the drug of choice in treatment of epilepsy, particularly in grand-mal seizures. It has

a narrow margin of safety or a narrow therapeutic window and when the concentrations reach above 20 ug/ml, symptoms of intoxication occur, while below 10 ug/ml seizure control is very poor. Hydroxylation of phenytoin by hepatic microsomal enzymes is a saturable process and the rate of metabolism changes from first to zero order if the doses administered are high, leading to non-linear kinetics. It is also highly protein bound, only the free drug being more active. Hence it is necessary to choose proper doses for achieving optimum levels.

It was reported earlier that undernutrition per se alters a number of pharmacokinetic parameters of several drugs. There is very little such information on phenytoin.

The subjects were epileptics on phenytoin therapy, with varying body weights. They were divided into two groups based on serum albumin concentrations. Vmax (using steady-state method) and Km were calculated on two different doses. Plasma phenytoin levels were determined by high pressure liquid chromatography. Correlations were calculated between Vmax and albumin, body weight, metabolic body weight and body surface area. The results of this study can be summarised as follows :

1. Body weights, heights, metabolic body weight and body surface area and body mass index were similar, though albumin levels were different (3.6±0.15 vs 2.8±0.13 g/dl).

2. Plasma steady-state levels at all doses tended to be lower in subjects with albumin below 3.2 g/dl.

3. Due to large variation Vmax and Km were not significantly different though they tended to be higher in patients with low serum albumin.

4. The only Correlation which was observed was between serum albumin and Vmax (r = 0.358).

These results are similar to ... on highly protein bound drugs. It indicat... that in undernutrition with low serum album... drugs tend to get metabolised faster d... to high availability of the free drug. Therefo... on 300 mg of phenytoin the malnourish... are unlikely to develop serum levels abo... 20 µg/dl, and on 100 mg, therapeutic failu... are likely to be encountered.

STUDIES ON INHIBITORS OF URINARY CA... CULI FROM NATURAL DIETS

Urinary calculi formation is an outcor... of an imbalance between stone forming a... inhibitory properties of urine which are infl... enced by diet, apart from other facto... It is desirable to increase the intake of foo... with potential inhibitory property besid... restricting high risk foods.

Tamarind is widely used in South Indi... diets, and it may be noted that the over... incidence of urolithiasis is far less in Southe... India, as compared to Central and Northe... regions. A study was undertaken to determi... the beneficial effects of feeding tarta... acid (a compound present in substantial amoun... in tamarind) to rats. Two groups of weanli... male rats were fed a calculogenic diet ... libitum for 3 months. One group of ra... received L + Tartaric acid at a level ... 50 mg/100 g. diet. At the end of the peri... it was observed that inclusion of tarta... acid in the diet resulted in (a) reduced inciden... (50%) of bladder calculi as compared to contr... (90%) and (b) Calculi developed in tarta... acid fed rats weighed 60% less than tho... developed in the control group.

This in vitro study which is the fi... of its kind, clearly demonstrated the bene... cial role of tartaric acid supplementati... in preventing the formation and growth ... urinary stones.

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UNIT

NUTRITION NEWS

NATIONAL INSTITUTE OF NUTRITION

HYDERABAD VOL.8 No.6 NOV 1987

CURRENT TOPIC

DROUGHT AND NUTRITION

Introduction

Water scarcity and crop failure are the main distressing features of drought, resulting in primary deficit of food, fodder and drinking water. The other socio-economic 'symptoms' of the scarcity situation are: Lack of employment for the landless and marginal farmers; emigration of families in search of livelihood; mass migration of cattle; increasing indebtedness and distress-sales of land and possessions. The scale and magnitude of these conditions, however, are directly dependent on the degree of drought and the destitution it causes among the people.

While emergency situations like drought, epidemics, floods, earthquakes and even man-made wars and political turmoils affecting large sections of population constitute a *management problem*, the technical issues involved in their control are no less important. This is particularly so when the objective is to accomplish the job on hand expeditiously, efficiently and cost-effectively. In the context of drought, going by experience, two tasks assume great importance.

1. Provision of work to the agricultural labourers rendered idle due to lack of work.

2. Supply of food to them and their dependents (in extreme situations even water supply becomes critical and it has to be carried over long distances).

Efficient management of these two tasks requires knowledge of (i) organising appropriate public works (ii) management of food and nutrition, so that the prevailing nutrition status does not deteriorate and develop into worst forms of malnutrition. This write-up deals with the latter issue.

A large body of scientific expertise and experience exists with the nutrition scientists in the country, regarding nutrition and dietary management under 'normal' as well as drought conditions.

Prevalent scenario

The prevalent position regarding food and nutrient intake as revealed by the diet surveys conducted on different segments of urban and rural populations, by National Nutrition Monitoring Bureau (NNMB) is presented in Tables 1 and 2.

Table-1

AVERAGE INTAKE OF FOODSTUFFS(gm/cu/day) IN DIFFERENT URBAN AND RURAL GROUPS

Socio-economic group	Cereals and millets	Pulses	Leafy vege-tables	Other vege-tables	Roots and tubers	Milk	Fats and oils	Sugar and Jaggery
URBAN								
High Income Group (HIG)	316	57	21	113	82	424	46	34
Middle Income Group (MIG)	361	49	21	89	78	250	35	31
Low Income Group (LIG)	428	42	16	55	66	95	22	28
Industrial Labour (IL)	420	41	13	56	67	98	23	29
Slum Dwellers (SD)	416	33	11	40	70	42	13	20
RURAL (All Groups)	522	37	13	58	51	90	12	23
Balanced Diet*	460	40	40	60	50	150	40	80

*Least cost balanced diet recommended by ICMR(1981) for adult sedentary male

Source : NNMB Urban Survey Report (1984).

Between the diets of urban poor and rural people, the diets of rural groups were far better than those of the urban slums, and in some respects different from those of industrial labourers and low income group.

Table-2

AVERAGE INTAKE OF NUTRIENTS (cu/day) IN DIFFERENT URBAN AND RURAL GROUPS

Socio-economic group	Protein (g)	Calories (Kcal)	Calcium (mg)	Iron (mg)	Vitamin A Retinol (µg)	Thiamine (mg)	Ribo-flavin (mg)	Niacin (mg)	Vita-min C (mg)
URBAN									
High Income Group (HIG)	73.4	2603	1121	27.3	881	1.47	1.52	15.3	98
Middle Income Group (MIG)	63.2	2364	821	26.7	555	1.32	1.17	15.0	70
Low Income Group (LIG)	57.8	2230	595	26.5	332	1.31	0.92	15.0	50
Industrial Labour (IL)	59.4	2243	548	26.3	352	1.35	0.94	15.9	47
Slum Dwellers (SD)	53.4	2008	492	24.9	248	1.27	0.81	14.6	40
RURAL (All Groups)	62.4	2366	576	30.8	270	1.41	0.92	15.5	40
Recommended Dietary Allo-wance (ICMR, 1981)	55.0	2400	400-500	24.0	750	1.20	1.40	16.0	40

Source : NNMB Urban Survey Reports (1984).

Within the rural groups, the landless labourers and marginal farmers group tended to consume nutritionally inferior diet (though a shade better than urban slum dwellers). Even the level of energy - the basic nutrient, in

their diets fell short of Recommended Dietary Allowances (RDA) (2400 Kcal/cu/day), leave alone vitamins and minerals. The data also suggested that about 80% of the total energy in the diets of these groups came from a single source, i.e., staple food (cereal or millet or a combination of the two). Thus, it is this section of the population, namely, the landless labourers, marginal farmers in rural area and the urban slum dwellers, who will be the worst hit group during drought; they constitute nutritionally vulnerable groups in such distress conditions.

Dimension of the problem of malnutrition

Nutrition scientists conventionally define the extent of malnutrition on the basis of indicators. These are : (i) prevalence of nutritional deficiency diseases (clinical indicator) (ii) growth deficit or retardation (anthropometric indicator) and (iii) nutrient deficit (dietary indicator). In recent years, the last one particularly, the deficit in energy content of diet has been extensively used for estimating the problem of malnutrition. As many as 50% of rural households and 55% of urban slum households fail to meet the daily requirements of energy and hence, are considered malnourished.

The survey data also suggest that among these communities, within the household (because of socio-cultural and physiological considerations), it is the preschool children and women who suffer most from dietary deficits. These categories are usually referred to as 'vulnerable groups', even under 'normal' conditions.

Diet and nutritional consequences of drought

The effect of drought is determined by the degree as well as the duration of drought on one hand and the erstwhile socio-economic status, availability of employment opportunities and the ability of family members to participate in the work and other relief measures, on the other.

Effect on diet

Gradual reduction in consumption levels of cereals and millets, which form the mainstay of diets of the poor, is the first event to occur. Varying proportions of the families, especially in severely affected areas consume diets with very low energy intakes. The average consumption levels in drought-hit parts of Andhra Pradesh, Maharashtra and Bihar were observed to be ranging from 1100 to 1400 Kcal per person per day - barely sufficient to meet the basic needs of metabolism. In severely affected areas of Andhra Pradesh, in the 1966 drought, as many as 36% of the families surveyed (as against 2% in least affected areas) subsisted on di supplying less than 500 Kcal per person per day, which a virtual 'starvation' diet. During the Bihar drought, t percentage of such households observed was 8.2 Secondly, because of scarcity of the staple, the norma unused portions of foodgrains like bran, husk,powder seeds of tamarind, etc., make their way into the dietari Even tree bark and ash formed part of the diets of peo under extreme drought situation. In addition, consumption levels of infested foodgrains, wild roots a tubers, green leaves, etc., increase. As a result, population is exposed to risks of food poisoning a toxicity of vital organs like liver etc. The epidemic hepatitis due to consumption of mouldy maize in part Gujarat in 1974 is well documented, though in this ca the scarcity was due to destruction caused by exc rains. Apart from humans, even animals, which dur drought are left to fend for themselves, are also expo to such risks of sudden illnesses and death.

Effect on nutritional status

At the overall level, the prevalence of overt clini nutritional deficiency signs shows a definite increa during drought. The signs of PEM, vitamin A deficien among children and anaemia among children a women show increased trend during drought but th magnitude often fails to indicate a clearcut relationsh with the degree of drought. Factors like degree utilisation of relief measures, intra-familial distributi resourcefulness of the women etc., seemed to modify prevalence of these conditions.

The percentage of frank signs of some nutritio deficiency or the other, irrespective of age and s groups, ranged from 30 to 55% as against 25-30% normal times. The prevalence of weight-for-age defici severe and moderate degrees (less than 75% of stand weight) in young children (considered as an index community undernutrition), showed definite rise several-folds and had a close relationship with the deg of drought.

A recent survey of the drought-hit Mahaboobna District of Andhra Pradesh by NIN revealed that :

1. There was a threefold increase in severe forms growth retardation (∠60% of standard body weight age).

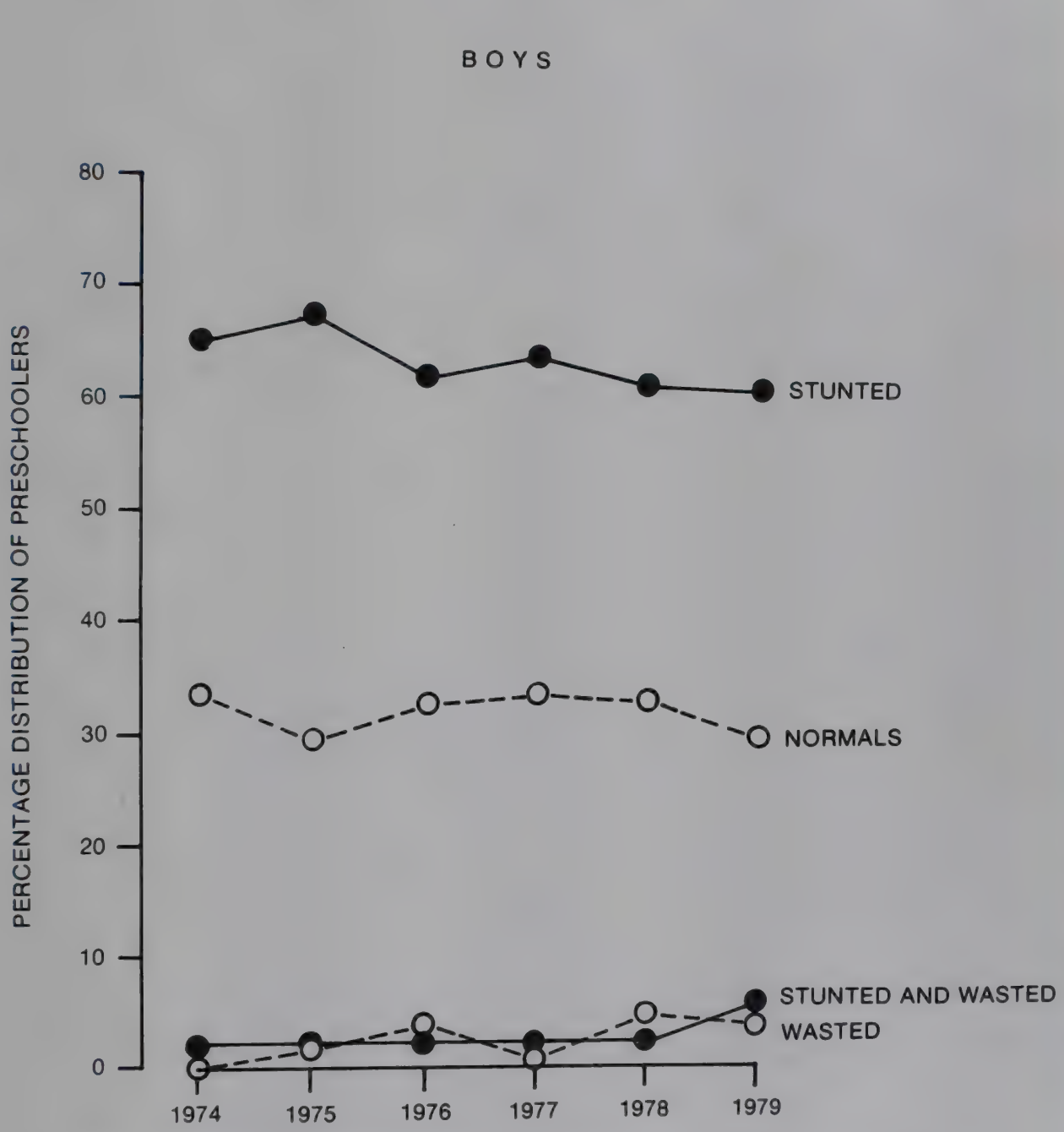
2. Incidence of frank protein energy malnutrit (marasmus and kwashiorkor) was 3% as against usually found.

3. The extent of stunting (low height for age) reflect prolonged type of undernutrition was 1½ times more t that reported under non-drought conditions.

UNIT
C.F.T.R.I. MYSORE

DISTRIBUTION OF RURAL CHILDREN (1-5 YEARS) ACCORDING TO 'STUNTING' AND 'WASTING' CLASSIFICATION (WATERLOW) IN MAHARASHTRA DURING THE PERIOD 1974-1979

(Source: NNMB Surveys)



Median Values of Heights and Weights of Well-to-Do Indian Children are used as standards.

'Stunting' : Children having height for age less than 90% of standard value.
'Wasting' : Children having weight for height less than 80% of standard value.
'Normals' : Children who did not exhibit 'stunting' or 'wasting'.

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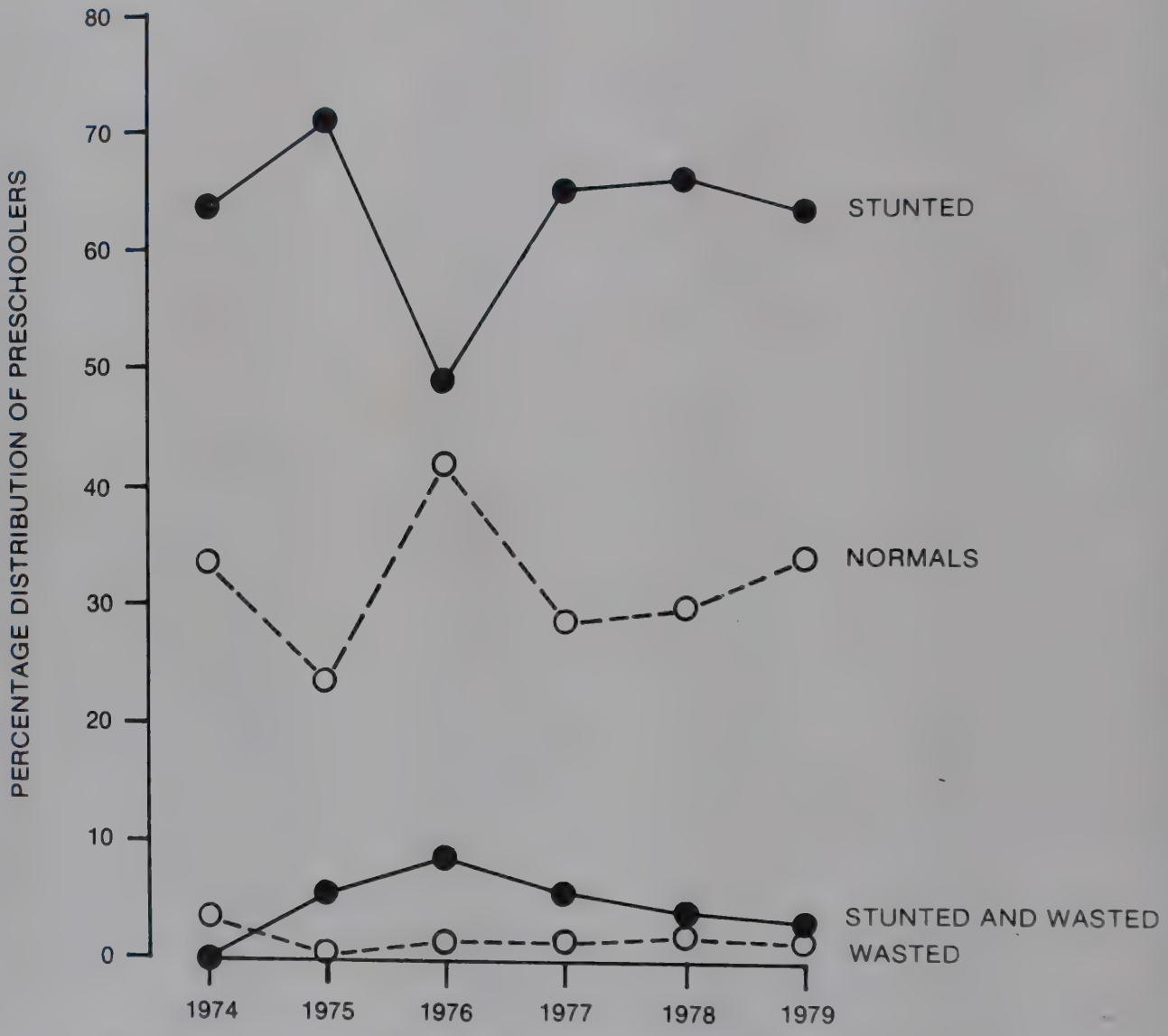

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These observations can be expected in view of the fact that this is the fourth consecutive year of drought in the area.

Control Strategy

The long term strategy for achieving control of recurring drought, no doubt, rests on effective use of surface and ground water and land resources for agricultural production on one hand and provision of employment to labour force engaged in agricultural sector on the other.

The scale of operation of relief measures is dependent on the extent of the area and numbers of people affected and the severity of drought in terms of crop failure and water scarcity. Fairly standardised procedures of assessment of degree of drought are usually available with the revenue and other governmental agencies.

Considering the fact that the present drought conditions have involved nearly two-thirds of the country, the scale of relief operations cannot be anything but gigantic.

The following are the general and specific suggestions, which form the mainstay of dietary and nutritional management of drought affected population :

General suggestions

1. Relief work

In organising relief works in the drought affected areas, an attempt should be made, as far as possible, to locate worksites nearer to the habitats of the affected people so that the energy spent in trekking long distances to reach the workspot is minimised. Also, in view of the limitations of energy intake, jobs involving very hard work should be avoided.

2. Food as wages

Part payment of the wages must be in terms of food (as is being done in NREP), and, wherever feasible, cooked food (ready-to-eat type) be supplied at the workspot.

Establishment of Fair Price Shops (if not existing already) and regular supply of foodgrains to the people should be ensured. It is suggested that the supply of grains preferably be effected in a mixed form, i.e., cereal + pulse or millet + pulse. (It is desirable that kerosene should also be made available through these shops).

3. Effective use of available departmental and voluntary channels

Active support of the voluntary agencies and informal village Yuva (Youth) and Mahila (Women) Kendras, etc., should be sought in the task of food preparation and distribution. They should be given the responsibility of mobilising the public support and cooperation in organising supervised feeding of the vulnerable groups and also ensuring regular supplies of grains in Fair Price Shops.

4. Drinking water supply

In severe situations, the conventional water sources like dug wells, streams, etc., get dried up. The need for supplying safe drinking water through tankers, carts etc., arises; hence contingent plans to meet drinking water needs of the people should be ready.

5. Augmentation of ongoing programmes

The ongoing nutrient supplement programmes like massive dose vitamin A distribution, and iron and folic acid (folifer) distribution etc., should be augmented on priority basis and in some cases the scope should be expanded to include other age and sex groups also.

6. Primary medical and health care

The existing medical and health care machinery should be geared, necessarily with mobile health teams to meet the contingencies of infections leading to diarrhoea, dysentery and fevers, which tend to assume epidemic proportions in such situations. Provision of first-aid (primary health care) facility at workspots to take care of trauma/injuries on emergency basis should be ensured.

Specific suggestions

1. Meal at workspot : It is suggested that each worker engaged in relief work, should receive at least one meal (supplying about 1000 Kcal) at the workspot. The rationale for this suggestion is to ensure consumption of at least 50% of the total calories habitually consumed by this group, the rest (about 1000 Kcal), to be met from the home diet. The meal should conform to the workers' food habits and take into account the least cost (local) staple and legume mixture. The cereal-pulse mixture may be cooked in porridge form (kichidi) or ground into flour and supplied as 'rotis' (unleavened bread, e.g., missi roti).

(i) Kichidi (Porridge)

Rice	250 g.
Pulses	15-20 g.
Salt and condiments (chilli powder) - to taste	

(ii) Roti (unleavened bread)

Wheat + millet flour (atta)	250 g.
Bengalgram flour (besan)	15-20 g.
Salt and condiments (chilli powder) - to taste	

Groups of women from the affected village can be employed to run such kitchens at different worksites. This activity itself could be considered as a means of income generation for womenfolk of the area concerned.

2. Family ration : An amount of 2.5 kg of foodgrains in the form of cereal/millet and pulse mix, should be ensured for a family of three adults and two children. Supply of grain in the form of mixture and preferably in the form of broken grains is suggested specifically to avoid resale or diversion of the foodgrains to open market by unscrupulous persons.

3. Cash for incidentals : Under drought conditions, it is preferable that majority - 70-80% of wages for work is paid in the form of food and the remaining in cash to meet the cost of fuel and other incidentals.

4. Distribution of iron and multi-vitamin tablets : This often forms the strategy of health department and should be integrated with the workspot meal programme and every worker be supplied with iron and multivitamin tablets.

- Dr. N. Pralhad Rao
- Mr. D. Hanumantha Rao
- Dr. B. S. Narasinga Rao

RESEARCH NOTES

MYELINOGENESIS IN UNDERNUTRITION

Earlier experiments to study mechanisms underlying myelinogenesis using labelled palmitate suggested an impaired capacity of rats to utilise fatty acid precursor for synthesis of specific lipid components of the brain. The capacity of myelin forming cells (oligodendroglia) to utilise the required precursors to lay down myelin is governed by biochemical [illegible] the brain, and is also influenced by nutrition inadequacy.

Undernutrition in pregnant rats was imposed by 5 per cent feed restriction from the 3rd week of gestatio and through lactation. Pups from control an undernourished groups of rats were sacrificed at 7, and 21 days of age. Two hours after intracerebr injection of BSA complexed (1-^{14}C) palmitate, brai were dissected out into cerebrum, cerebellum and bra stem. Myelin and Myelin-like subfractions were isolate using sucrose gradient centrifugation and osmot shocking. Lipids extracted from these membran samples were analysed. The results can be summarise as follows :

1. A decreased incorporation of (1-^{14}C) palmitate in myelin and 'Myelin-like' subfraction was observed undernourished rats at 7, 14 and 21 day in all the thr regions, the difference being higher in the brain stem 21 days. 2. Specific activities of total lipids from the myelin subfractions also showed significant reductio in the case of feed restricted animals. 3. Incorporatio into phospholipids and cerebroside fractions of myel from cerebellum and brain stem was lower at 21 da whereas incorporation into these lipids from myelin-li subfraction showed an increase.

These investigations point to adverse effects of ea undernutrition on the process of myelinogenesis, evidenced by lower incorporation of labelled precurs (1-^{14}C) palmitate into myelin and its marker lipids and a suggestive of defective transfer of the marker lip constituents from their site of synthesis, i.e., t endoplasmic reticulum of the glial cell to myel membrane.

TRAINING PROGRAMME

The Twentyfifth Annual Certificate Course Nutrition will be held between Ist December 1987 a 29th February 1988. Two candidates from Afghanist and fifteen from different States of India are expected participate.

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